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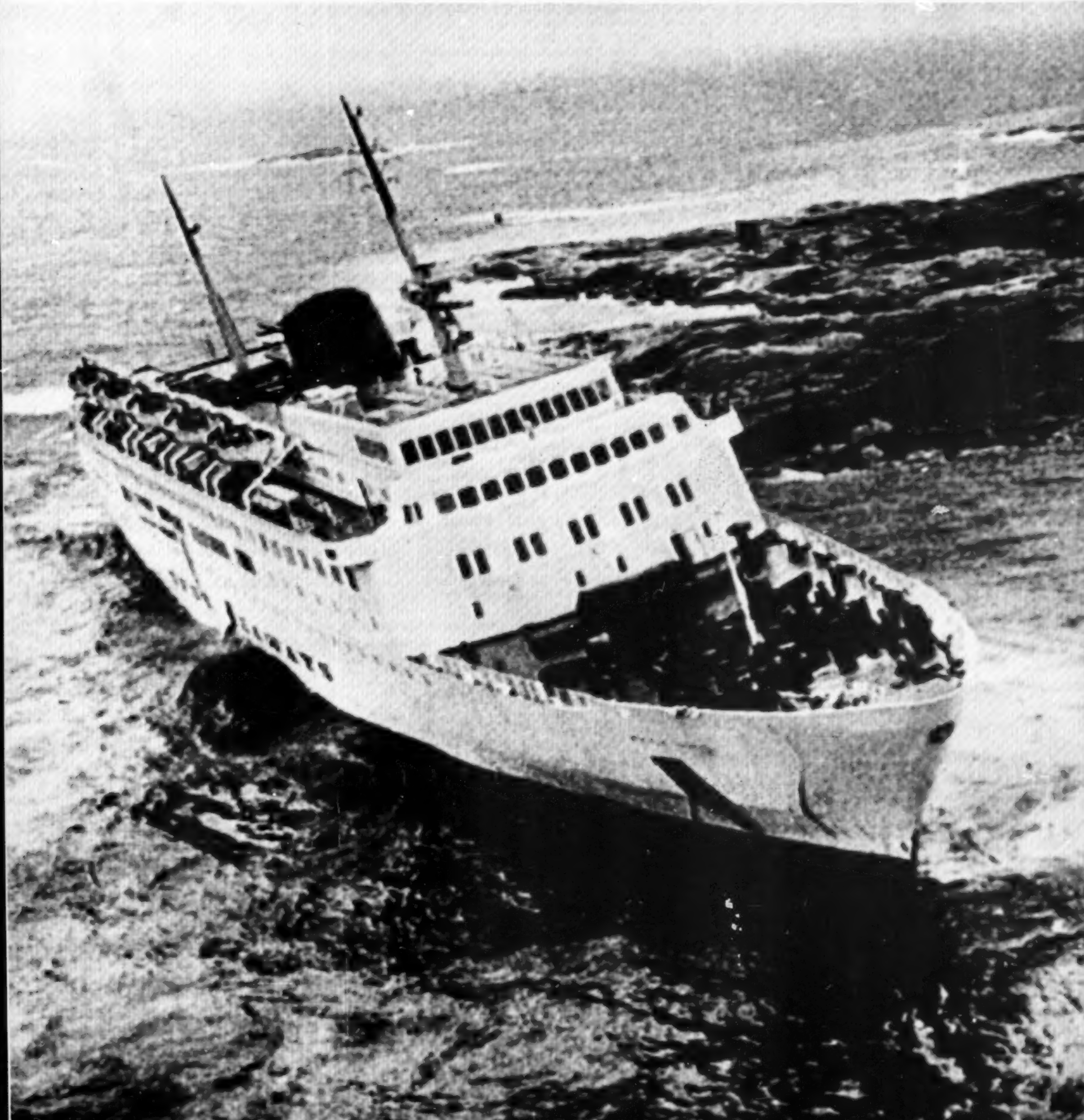

Mariners Weather Log

Editor: Elwyn E. Wilson
Editorial Assistant: Annette Farrall

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Cover: Hard aground! The Danish ferry WINSTON CHURCHILL ran aground on August 26, 1979, in rough weather near the Swedish port of Gothenburg. Pictured here the following day she lies heavily on the rocks near the lighthouse Vinga. No serious injuries were reported. Wide World Photo.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget through June 30, 1980.

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Mariners Weather Log

DRIFT OF THE VENOIL IN THE AGULHAS CURRENT

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What was potentially the worst marine pollution disaster of all time occurred southwest of Cape Seal on the South African south coast in December 1977. On December 16 the fully laden 330,954-ton supertanker VENOIL collided with her sistership VENPET, the latter being in ballast and heading the opposite way; namely, back to the Persian Gulf. After the impact both ships were dead in the water and ablaze, while oil started spilling from their hulls in great quantities (figs. 1 and 2). A major rescue operation was mounted immediately by about 10 merchant ships in the vicinity at the time and by a helicopter serving the oil rig SEDCO K nearby. Of the 84 men serving on the vessels, 2 lost their lives, while 8 sustained minor injuries in the collision and its aftermath.

Slicks involving approximately 26,000 tons of oil soon covered an extensive area of the sea in the vicinity of the collision, but initially offshore winds prevented oil from reaching the coast. Five pollution control vessels of the South African government, aided by spotter aircraft, proceeded to spray the oil with dispersants. Had the VENOIL broken up, as was expected, and its enormous cargo released, further attempts to control the pollution most probably would have been futile. Ecological damage to South Africa's south coast, which includes some of its most beautiful and undeveloped coastal areas and marine parks, without doubt would have been disastrous.

The fire on board the VENPET was fought with the help of the supply ship SMIT LLOYD 90, which took the tanker in tow on the 17th and moved her away from the coast. Eventually, she was towed to Cape Town, where temporary repairs were made. Once the fire on the VENOIL had been extinguished, the vessel was taken in tow by the oil rig service vessel BOLTENTOR, which relinquished her tow on arrival of the deepsea tug WOLRAAD WOLTEMADE. Officials of the South African Department of Transport instructed the tug to tow the damaged tanker away from the coast immediately in an attempt to remove the threat of coastal pollution.

SALVAGE OF THE VENOIL

As the tug and tow moved away from the coast, some serious problems arose. The collision and subsequent fire had caused extensive damage to the bow section of the ship (fig. 1). and the VENOIL had to be towed by the stern. The master of the WOLRAAD WOLTEMADE soon reported excessive sheering of the tow in a pendulum fashion up to 90 degrees to either side of the direc-

Figure 1.--Bow section of the VENOIL after the fire, which started shortly after the collision with her sistership VENPET. Extensive damage from both the collision and the fire can be seen. Photo courtesy of Die Burger.

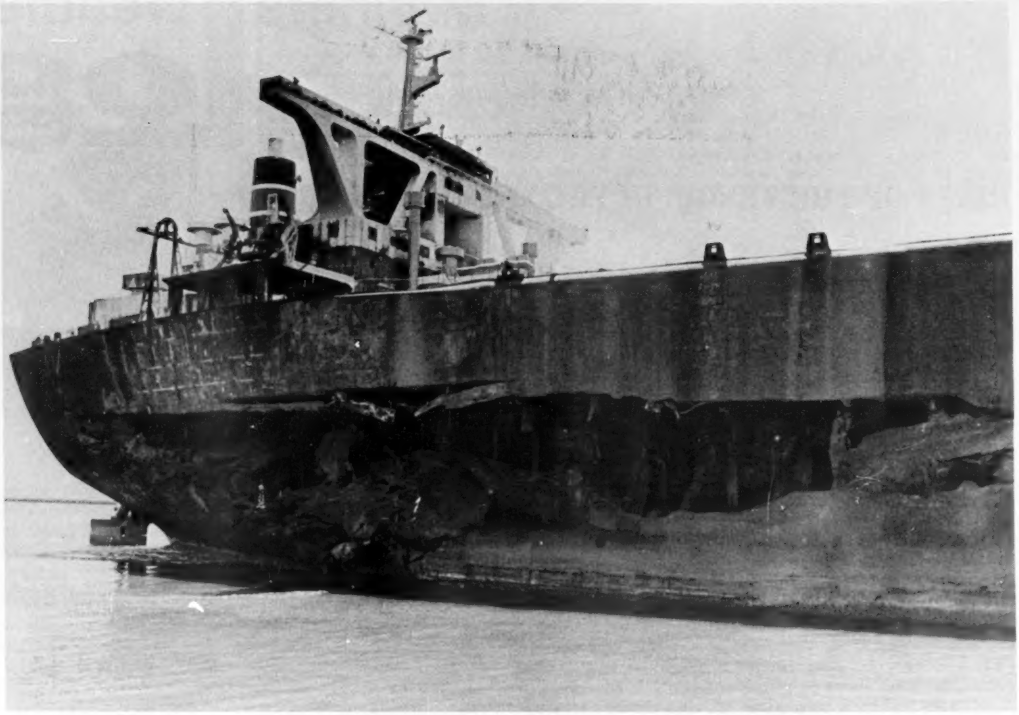

Figure 2.--The starboard side of the VENPET upon reaching Table Bay Harbor in Cape Town for temporary repairs. The extent of the damage is brought into perspective by noting the size of a crewman on deck above the torn hull. One of the anchors of the VENOIL was torn loose and is visible in the forward part of the gash in the VENPET's side. Photo courtesy of Die Burger.

tion of tow. This constant sheering of the tow made it difficult, and often dangerous, for the tug to maintain a specific heading.

The tortuous track followed by tug and tow during this period is shown in detail in the box in figure 3, in which position fixes and times are given from 1200 on December 18 to 2006 on December 20. By 2000 on the 20th the wind, which until then had been variable, increased in force and blew more steadily from the southwest. The tug's master reported at this time that it was impossible to hold the tow in any direction other than southeast. It may be surmised that towing a supertanker by the stern in the direction opposite to its hydrodynamic shape can cause excessive sheering of the type experienced and that strong southwesterly to southerly winds help to overcome this tendency. These strong southerly winds, unfortunately, also caused large quantities of spilled oil to be blown onto the beaches and into lagoons of the south coast of South Africa, causing extensive and long-lasting pollution.

By this time the tug and tow had crossed into the strongest part of the Agulhas Current and moved with the current towards the southwest until December 23, when with the aid of the tug LLOYDSMAN tugs and tow succeeded in moving out of the Agulhas Current at about 38°S latitude and then proceeded to the northeast. Good progress was made, and on December 31 the ships reached Algoa Bay (Port Elizabeth, fig. 1), where the VENOIL's cargo was transshipped at sea to the tanker LITIOPA in what is believed to be the largest ship-to-ship transfer at sea to date.

AN OCEANOGRAPHIC INVESTIGATION

The course taken by the WOLRAAD WOLTEMADE is shown in detail in figure 3. It seems clear that the tug and tow were advected far to the south of their destination by the fast-flowing Agulhas Current. One can reasonably assume that, had the master of the tug been aware of the exact geographic location of the core of the current at the time, he may have been able to avoid it, thus minimizing the costly salvage time as well as the danger involved in the operation. Safmarine Corporation, owners of the WOLRAAD WOLTEMADE, thus had requested the National Research Institute for Oceanology of the South African Council for Scientific and Industrial Research (CSIR) to undertake a satellite imagery study of the ocean area in question for the period of the salvage operation. It was hoped that in this way an oceanographic background of conditions experienced

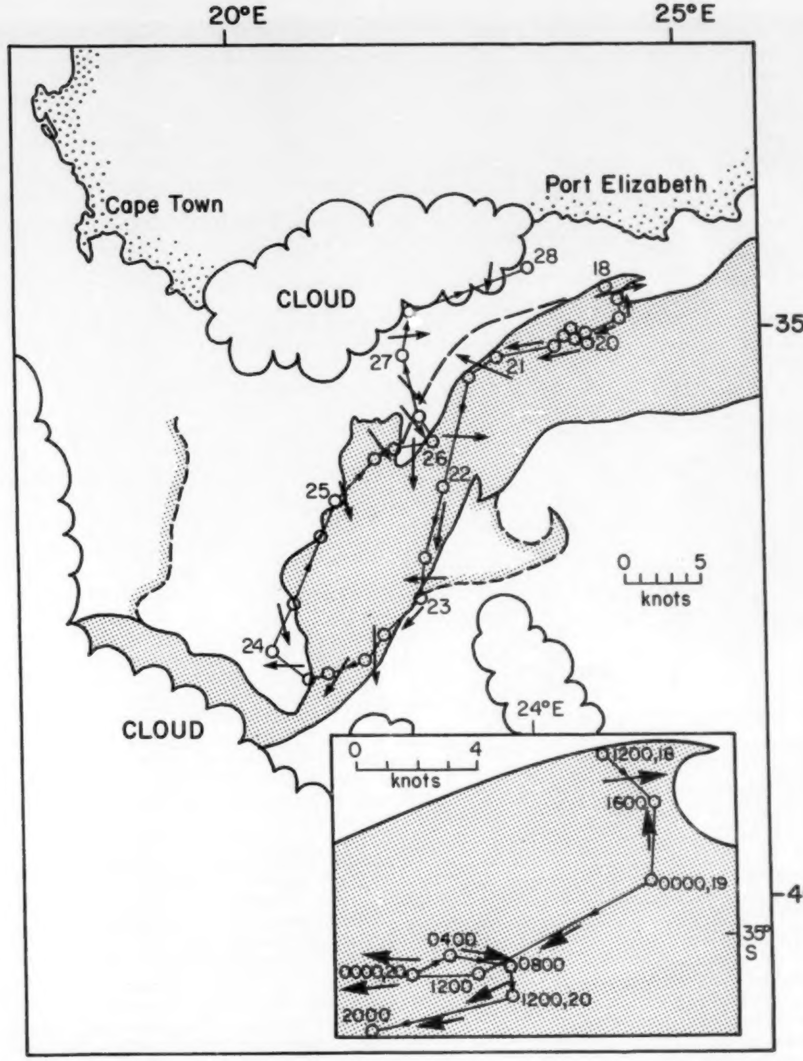

Figure 3.--Ships' track and position fixes at 1200 each day and current sets experienced during the salvage of the supertanker VENOIL. These are superimposed on the sea-surface temperature delineation of the position of the Agulhas Current for December 16, 1977. The ships' track for the first 2 days is portrayed in an enlarged version in the lower righthand corner. The dashed line demarcates the position of the landward edge of the Agulhas Current on December 21, 1977.

at the time could be obtained. Results of this investigation indicated that, in principle, the position of a ship relative to the current may be determined from satellite images, but because of various factors it is difficult to do this either accurately or in real time.

The Agulhas Current is in many respects similar to the Gulf Stream off the eastern seaboard of the North American continent and also to the Kuroshio Current found off Japan. Its general geographic configuration as derived from ships' drift over many years may be inferred from figure 4. It shows that the frequencies with which certain current velocities are experienced are quite variable. Off Durban the current is very stable and persistent. In the areas

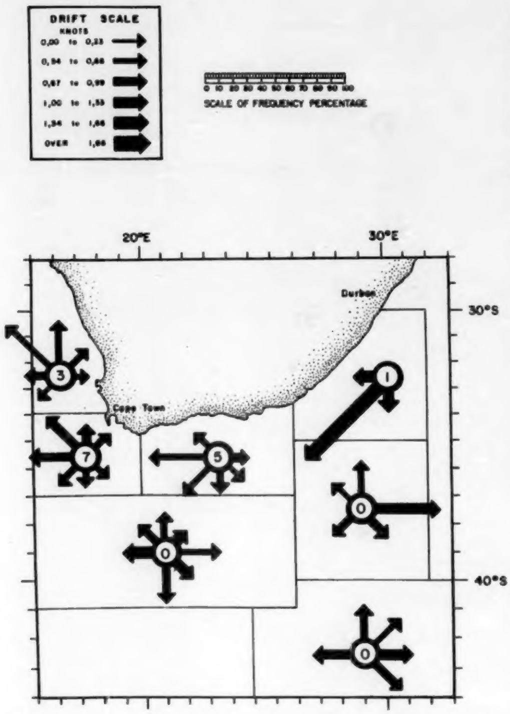

Figure 4.--Current roses representing frequency of direction and average drift of ocean currents within each outlined area for December. Numbers indicate percent occurrence of no appreciable current. (After: Atlas of Surface Currents - Indian Ocean, U.S. Navy Hydrographic Office, Pub. No. 566)

between 20° and 25°E current speeds are lower, and current directions vary over many points of the compass.

Because of the importance of the Agulhas Current to conditions in the ocean areas adjacent to South Africa, a considerable research effort has been directed towards understanding its behavior. However, most of this work has been concentrated off South Africa's east coast in the vicinity of Durban and in the ocean area east of 30°E.

Our present oceanographic understanding of the current's behavior in the area of interest therefore is not comprehensive, but a number of salient characteristics have emerged. In the first instance the general description of the geographic location of the current as interpreted from ships' drift has been supported by several investigators. It has been shown that the current is geographically persistent and well defined between Durban and Port Elizabeth. West of Port Elizabeth the axis of the current seems to follow the southern edge of the Agulhas Bank which starts to diverge from the coast at this point. On leaving the edge of the Agulhas Bank at about latitude 37°S the current shows a strong tendency to turn back on itself and to flow in a northeasterly direction before being absorbed in the general flow of the Antarctic Circumpolar Current. The important steering effect of the changing bottom topography at various locations has been noted by several investigators.

Another important feature of the general circulation that has been noted is the variability of the current, especially after it is no longer under the steering effect of the Agulhas Bank. Contemporary research has also supported the interpretation of the accumulated ships' drift as depicted in figure 4.

Published scientific current measurements made in the area fall into the categories of analyses of ships' drift and of satellite-tracked buoys. The most detailed of these show many different filaments of current and intense eddies in which the velocity may vary between 0.8 and 6.6 kn. No regular monitoring of current velocities has yet been attempted in this particular area, but when this was done on the Agulhas Current off Durban, large variations were detected.

One may conclude that the Agulhas Current's position is fairly stable in a limited geographical area only, that its velocity may vary considerably at any one location, and that in the area under consideration various eddies, meanders, and current filaments of quite different velocities may occur.

OCEAN CONDITIONS DURING THE SALVAGE

A certain amount of data, some of it rather circumstantial, is available on the drift of the WOLRAAD WOLTEMADE and the VENOIL. Accurate position fixes, course steered, speed on log, wind and swell conditions, as well as brake horsepower were logged regularly. Regular daily sea-surface temperature readings were also taken (table 1). For this purpose water was drawn off the engineroom intake and its temperature measured with a mercury-bulb thermometer. Results cannot be regarded as accurate values of sea-surface temperature, but do indicate when the vessels crossed the edge of the current. Apart from this information, further fortuitous evidence of the location of the current at that time is available in the form of thermal infrared satellite imagery. Images from the NOAA-5 satellite are available for December 16, 1977, when there was very little cloud cover in the area and a very clear portrayal of the current's disposition was possible (fig. 5).

The dark, warm landmass in figure 5 is clearly outlined, and the stark, white bands of cold clouds also stand out. The ribbon of warm Agulhas Current water is clearly visible, while a number of other interesting features may also be noticed. Near Durban the Agulhas Current is close inshore and has a smooth edge. This smoothness may be a transitory, unstable phenomenon, since lateral waves have started to form near Al-

Table 1.--Sea-surface temperatures measured on board SA WOLRAAD WOLTEMADE during salvage of the ULCC VENOIL

Date in December 1977	Approximate time (SAGT)	Temperature (°C)
17	2359	22
18	2400	26
19	2400	26
20	2359	26
21	2400	26
22	2358	26
23	2359	26
24	2400	22
25	2400	23
26	2300	26
27	2458	24
28	2345	22
29	2400	22

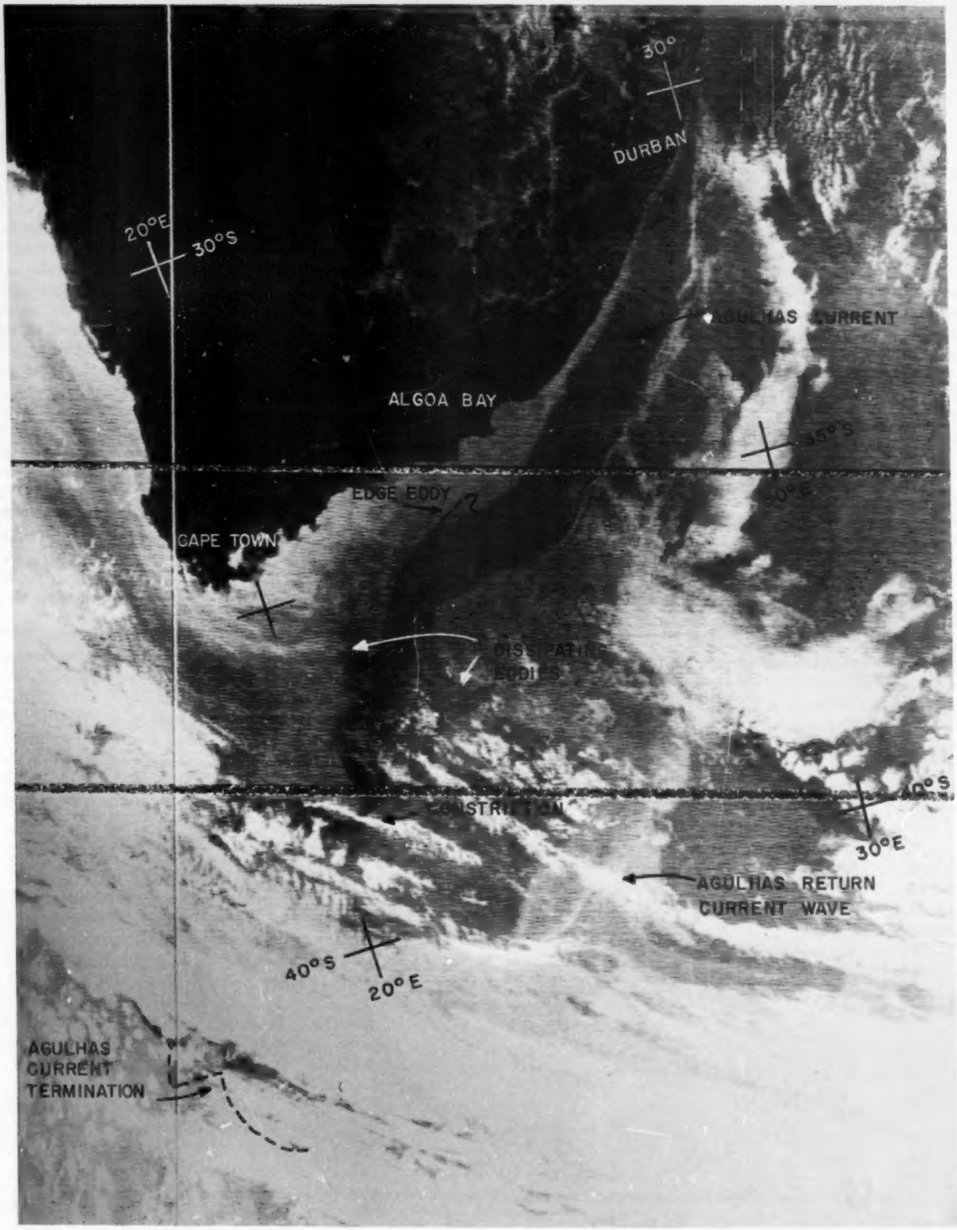

Figure 5.--The disposition of clouds and ocean currents in the vicinity of South Africa on December 16, 1977, as portrayed by an infrared temperature sensor on the NOAA-5 satellite. The warm landmass is black, while cold clouds are the main white features. The dark ribbon of Agulhas Current water with its attendant eddies is noticeable. The geographic distortion from the Earth's movement during satellite overflight and global curvature, noticeable here, has been rectified in figure 3.

goa Bay, and farther downstream there is a shear-edge eddy. A few dissipating eddies are also visible at both edges of the current. The flow of water goes through a severe constriction at about 38°S, while the southwestward termination of the current occurs at about 42°S, 18°E. An extensive wave in the Agulhas Return Current is also apparent.

An attempt was made to combine all these complementary data into a coherent descriptive whole. Current sets between position fixes were calculated, but because of the limits of accuracy of the navigation by Omega as well as many changes in direction and speed of the ships, these are of a crude nature at best. They nevertheless show a strong correlation with the Agulhas Current position as deduced from sea-surface temperatures. This may be seen in figure 3, where the ship's track, position fixes, and calculated current velocities have been superimposed on an interpretation of the satellite image of figure 5. Because of the manual rectification of this image to a Mercator projection, positions may be accurate to only about 30 km.

INTERPRETATION

On crossing the edge of the warm Agulhas Current at about 1200 on December 18 (table 1), the tug and tow moved into a current edge eddy and in fact may have experienced a current set in a direction opposite to the general flow of the current (fig. 3). On moving across the southern edge of the eddy at about 2400 on the same day, the ships experienced the full effect of the current for the next 8 hr, as is evident from the current set in figure 3. Subsequent movement within the envelope of warmer water was characterized by current sets in directions that correspond with the direction of the current as implied by the thermal demarcation, and this occurred with few exceptions. On moving out of the current at about 0800 on the 24th (fig. 3), substantiated by a drop in temperature of 4° (table 1), the ships experienced a sharp drop in current sets which continued for most of the return voyage.

Two notable exceptions to this general description are evident. During the midday period on December 23 unusually slight current sets were experienced. This seems to indicate that the vessels had crossed the seaward edge of the current at this time, an interpretation which is confirmed by the limits of the current expressed in figure 3. Since temperature measurements were only taken at 2400 each day, this short excursion from the body of the current is not noted in table 1.

A more serious complication occurred on December 26 and 27 when, on crossing the assumed position of a dissipating eddy, the ships experienced no corresponding current sets; instead, on proceeding northward, they experienced strong current velocities in areas where the current had not been present on December 16 according to infrared imagery. The former inconsistency is resolved by the fact that eddies of this nature have been observed to move downstream while rapidly dissipating and losing their coherence.

The stronger current sets experienced from about 1600 on December 25 to 1200 on December 27 can be understood by referring to the dashed line in figure 3, which portrays the edge of the current as seen on a NOAA-5 satellite image for December 21, 1977. Within the accuracy of the rectification, it is apparent that this edge had moved so far to the west during this time that most of the position fixes in question fell within the current. This interpretation is consistent with the higher temperatures measured on these days, particularly December 26 at 2300 (table 1).

CONCLUSIONS

The use of satellite remote sensing can improve our understanding of certain oceanic features which are directly related to shipping and salvage operations in the varying conditions south of South Africa. Considerable progress has been made already in routing vessels near the United States using remote-sensing information. In a joint experiment by Exxon and NOAA, it was shown that a 3-percent fuel savings can be achieved.

Such endeavors are not yet possible in South Africa. Position-fixing accuracy on satellite images and general resolution for most products are not sufficiently high to allow more than the descriptive type of analysis based on the mostly circumstantial evidence given above. Ships sailing in the area can contribute to our understanding of the complicated current systems found here, if they are equipped with accurate satellite navigation instrumentation and with a well-calibrated thermograph.

ACKNOWLEDGMENTS

Parts of this article were published in the South African Journal of Science (October 1978), which I thank for permission to republish figures and text. Thanks to Captain O. E. Grapow of the Safmarine Corporation and the master of the SA WOLRAAD WOLTEMADE for making the logbook of the tug available and to Mr. R. Koffler of NOAA's National Environmental Satellite Service who activated the satellite in our area and relayed the information to us.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

TYPHOON HOPE, AUGUST 1979

Mariners Weather Log

Gordon J. Bell
Director, Royal Observatory
Hong Kong

On August 2, 1979, typhoon Hope crossed Hong Kong bringing the strongest winds since typhoon Rose on August 17, 1971. In both typhoons peak gust speeds were generally around 100 kn, increasing to about 130 kn at elevated sites (fig. 6). These typhoons were not as intense as such major storms as Wanda (1962) or Ruby (1964), but nevertheless they inflicted great suffering and economic loss. Typhoon Hope caused 12 deaths and 260 injuries. During the passage of the typhoon, 18 oceangoing vessels were adrift in the harbor and there were 10 collisions. A number of factors combined to reduce the loss of life. First, the community was very well warned and was well prepared for a major storm; second, Hope crossed the port at a high speed of 17 kn, so that the duration of gales and hurricane-force winds was short and rainfall moderate; third, tide levels were low; and, finally, the worst conditions were during daylight.

The most remarkable feature of Hope was its extremely high speed of movement. During the 6 hr prior to its arrival at Hong Kong, the storm averaged 24 kn (fig. 7), peaking at 28 kn on August 2 during 0245 to 0345 GMT.* The average speed over 6 hr of tropical cyclones in the tropical western Pacific Ocean is 9.5 kn; and in the 95 yr since 1884 only 53 storms have traveled faster than Hope. Of course, tropical cyclones that have recurved out of the Tropics into the westerlies often travel eastward at high speed.

The fast approach of Hope caused windspeeds at Hong Kong to rise rapidly (fig. 6). The 10-min mean

*Add 9 hr for Hong Kong time.

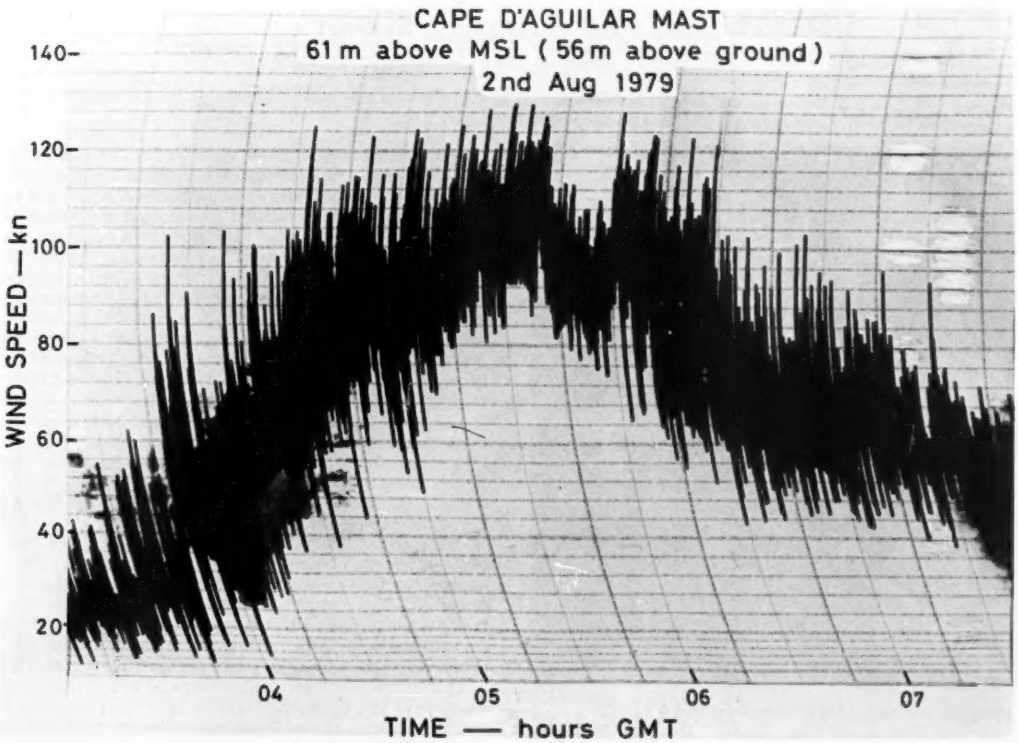

Figure 6.--A cup anemometer record made in Hong Kong during typhoon Hope showing a peak gust speed of 130 kn. The maximum 10-min mean is 108 kn and the maximum 60-min mean is 100 kn.

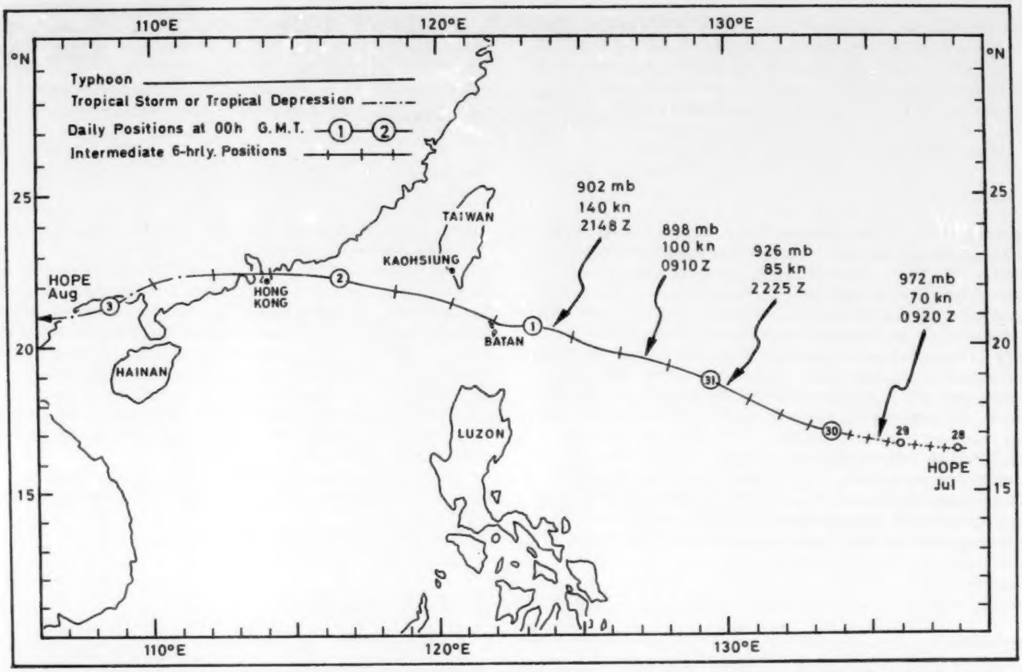

Figure 7.--The track of typhoon Hope. Maximum 1-min mean winds and minimum sea-level pressures are derived from U.S. Air Force reconnaissance observations.

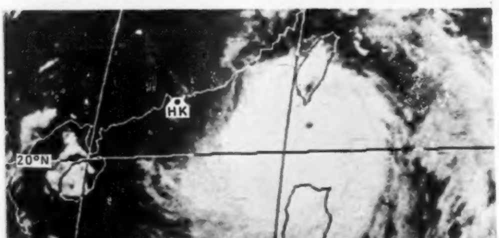

Figure 8.--An infrared image of typhoon Hope received at Hong Kong at 0900 on August 1 from the Japanese Geostationary Meteorological Satellite located over the Equator at 140°E.

windspeed increased from about 25 kn to 108 kn in 2 hr. The wind trace in figure 6 is from a cup anemometer mounted on a tower 61 m above m.s.l. and close to the shore. The temporary reduction in windspeed on this record just after the peak occurred when the wind direction backed from west to southwest, putting the anemometer downwind of an offshore island. A Dines pressure-tube anemometer at the Tate's Cairn radar station (568 m above m.s.l.) recorded 123 kn which, when corrected for air density, indicated a true windspeed of 132 kn. It is fortunate that the center of the typhoon passed about 6 mi north of the harbor, rather than an equal distance to the south, because in the latter case the motion of the storm would have increased the speed of easterly winds over Hong Kong by some 20 kn, and the typhoon would have been less weakened by the effects of land. In the harbor gales started from the northwest and backed to the southwest and south as the typhoon passed.

Hope (fig. 7) formed on July 29 and deepened rapidly--often called explosively--during July 31. Observations from a U.S. Air Force reconnaissance plane late that day at 2148 indicated a minimum central pressure near 898 mb, and sustained winds of 128 kn with gusts to 180 kn. Hope then passed about 15 mi north of the island of Batan, where sustained winds of 100 kn and a minimum pressure of 950.9 mb were recorded. A nighttime infrared satellite picture of the storm received at the Royal Observatory in Hong Kong from the Japanese GMS satellite during this period shows an eye that was 10 to 15 mi in diameter (fig. 8),

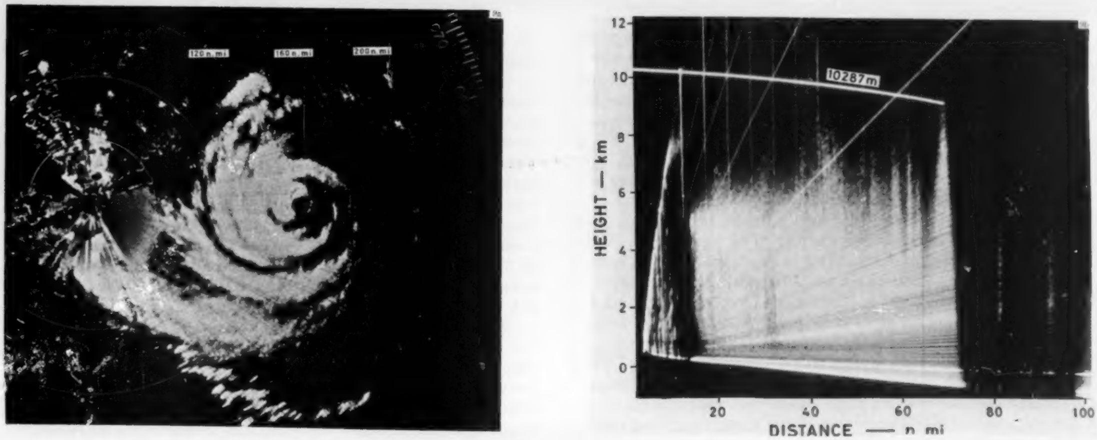

Figure 9.--Typhoon Hope as seen on the Royal Observatory, Hong Kong, Plessey 43S radar (a) at 2357 on August 1. Rainfall rates over 100 mm/h appear black, and they are surrounded by brighter areas corresponding to rates between 25 and 100 mm/h. A radar cross-section of the typhoon at 0209 on August 2 is shown in (b). The vertical range markers are at intervals of 5 mi, and the range marker extends to the outer eye wall at 68.5 mi. The inner eye wall is shown at ranges of 80 and 92 mi on either side of the clear eye at 86 mi.

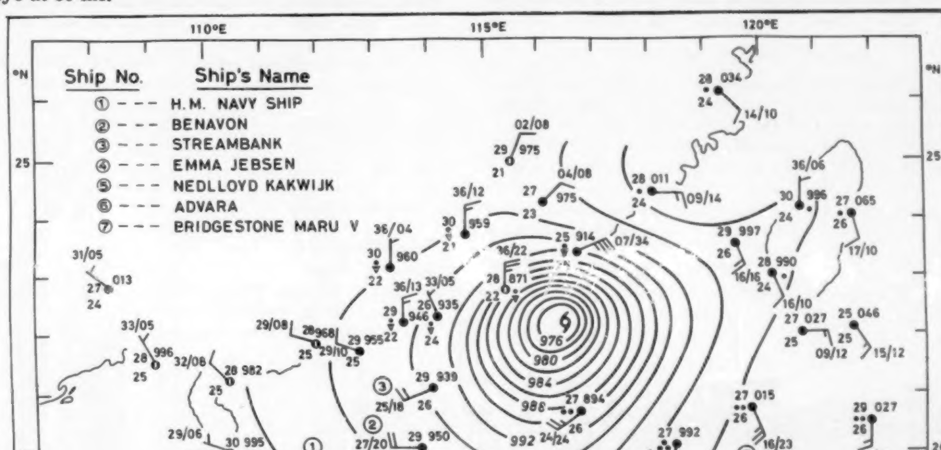

Figure 10.--The weather chart for typhoon Hope at 0000 on August 2, 1979, showing the ship reports received at the Royal Observatory, Hong Kong. Reporting vessels can be identified by the circled numbers. Reports from Pratas and Paracel reefs are plotted.

in good agreement with earlier reconnaissance reports. It is probable that the typhoon was at its greatest intensity at this time and that it then gradually weakened as its circulation embraced more of Taiwan and northern Luzon and began to move into the China mainland. The lowest pressure recorded in Hong Kong was 957.9 mb at Chek Lap Kok, but this station was not in the eye. Calculations indicate that the lowest central pressure should have been close to 951 mb.

Figure 9a shows the rainfall pattern in Hope as seen on the Hong Kong weather radar. The small eye, still only about 10 mi in diameter, is centered 130 mi east of Hong Kong. The surrounding circular, concentric rain band about 10 mi farther out is typical of storms in which the central pressure is about 950 mb or less. The radar presentation indicates that the maximum rate of rainfall in the eye wall is over 100 mm/h. The rainfall rates are volume averages and are not always directly comparable to gage readings; nevertheless, two rate-of-rainfall gages at Hong Kong recorded rates (15-s means) of 184 and 251 mm/h during the passage of Hope. The eye positions reported by Hong Kong and Kaohsiung radars were in perfect agreement until August 2. At this time Hope was centered more than 210 mi from the Kaohsiung radar, and reports from there fixed the typhoon about 10 mi too close to the radar. This is a common feature of radar fixes of tropical cyclones at extreme range when a complete eye wall cannot be seen.

A photograph showing a radar cross-section of the typhoon when the eye was 86 mi east of Hong Kong is shown in figure 9b. The inner eye wall shows faintly at 80 mi and 92 mi with the more intense outer eye wall extending to a height of 10.3 km indicating strong updrafts there. The height of the rain columns is low for such an intense typhoon. This means that the entire eye wall did not appear on radar at ranges beyond about 150 mi (Bell, 1977). The 0°C level was near 5.77 km in the eye wall, so that raindrops above this level were supercooled and their temperature was as low as -30°C in the tops near the marker in figure 9b.

Figure 10 shows the weather chart for 0000 on August 2 with the ship reports received at that time. In the harbor there were about 124 ships riding to typhoon buoys and anchors. The mooring cables of 10 vessels parted, and 1 ship went adrift with its buoy attached. Eight vessels dragged anchor, six of them colliding with other vessels, and one dead ship was grounded. The 10,300-ton Greek vessel ARGONAUT rammed the piers of the Star Ferry, causing serious damage, and ended up alongside the Kowloon Public Pier (fig. 11). Another pier was damaged by the 6,300-ton Panamanian freighter LAMMA ISLAND. Vessels dragging anchors broke cross-harbor telephone cables and disrup-

Figure 11.--The 10,300-ton Greek container vessel ARGONAUT aground alongside Kowloon Public Pier after having damaged the Star Ferry Pier. Photo courtesy Ta Kung Pao newspaper.

ted communications.

As a rough working rule, I find that about 13 percent of vessels in Hong Kong harbor break loose from their moorings in typhoons in which gusts near sea level reach 100 kn; the number increases to 35 percent in gusts of 120 kn. The surrounding hills increase the turbulence of the wind, which swings more than usual, so that gusts can catch vessels abeam when their cable is already under stress from wind and current. The Hong Kong Marine Department recommends that two shackles (55 m) of chain should connect the vessel to the buoy via the anchor-cable hawse, that ballast tanks should be filled, and that the second bower anchor should be dropped under foot with the ship's propulsion machinery being used to ease the strain on the cable. The latter is a difficult task because of the poor visibility in typhoon rains, and ships sometimes overrun their mooring or anchor and run aground against the wind (e.g., USS REGULUS during Rose in 1971). The chain is sometimes shortened to avoid excessive excursions with the attendant risk of collision. In addition, swell and storm surge (rise in water level in storms above the astronomical tide) at such times can be the "last straw" leading to breakage of cable or shackle--the latter accounting for 35 percent of failures. In Hope, the surge in Victoria Harbor was only 1.45 m above the predicted tide, but the surge in Tolo Harbor (an inlet to the northeast) was both large (3.23 m) and rapid (fig. 12). The storm surge in Hope was well predicted. Figure 12 shows that the Royal Observatory storm-surge numerical model for bays worked well in this instance.

Finally, it is probable that Hope continued westward, as an upper air vortex, and merged with a depression at the head of the Bay of Bengal on August 5. This monsoon depression crossed India to bring the rains which caused the tragic failure of the Morvi earthwork dam on the Machchu River in Gujerat State on August 11, 1979. Hope and its remnants would then have covered more than 4,000 mi. The timing for such a sequence is appropriate; however, satellite pictures and conventional data from Burma do not permit the merging of the two systems on August 4 and 5 to be positively verified, but this sequence could account for the intensification of the Bay depression on August 5.

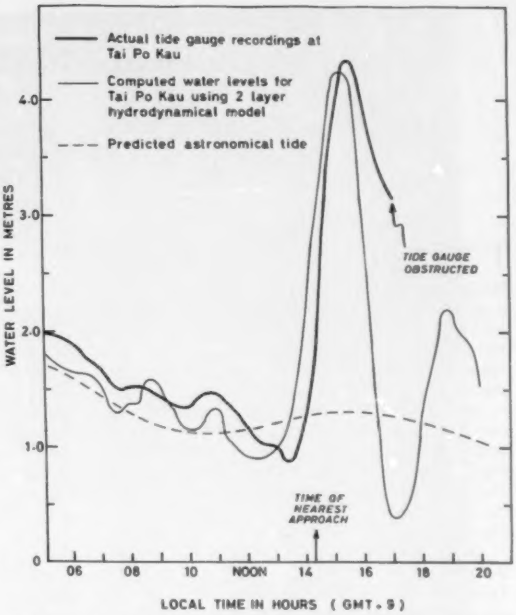

Figure 12.--Tide gage readings from Tai Po Kau pier in Tolo Harbor (an inlet northeast of Hong Kong) show that the water rose 3.46 m in less that 2 hr. The thinner curve shows the water levels predicted by a two-level mathematical model of Tolo Harbor.

REFERENCE

Bell, G. J., 1977, Comments on "Cape Hatteras Radar Observations of Hurricane Gladys," Monthly Weather Review, 105, p. 550.

Mariners Weather Log

TROPICAL STORMS MAC AND NANCY

Elizabeth Lo
Royal Observatory
Hong Kong

There have been very few occasions when two tropical cyclones have been centered within 400 mi of Hong Kong at the same time (fig. 13). On this occasion the Stand By Signal, No. 1, was hoisted for tropical storm Nancy, but as Nancy moved westward across Hainan Dao (Hainan Island) severe tropical storm Mac approached from the southeast, and the Stand By Signal therefore remained hoisted.

Nancy first formed as a tropical depression off Hainan Dao. At 0000 on September 19 it was about 250 mi south-southwest of Hong Kong. Satellite pictures during the afternoon indicated that Nancy was intensifying. The Stand By Signal was hoisted at 0700 on September 19, when Nancy was 270 mi southwest of Hong Kong (fig. 14).

Nancy moved westward across Hainan Dao late on the 19th. The following evening it left the Island near Yulin, where a minimum sea-level pressure of 993 mb was reported. A station near the east coast of the Island reported maximum winds of 26 kn with gusts to 48 kn. Nancy continued on a westerly course towards north Vietnam, but on September 21 it intensified into a tropical storm over the Gulf of Tonkin. The minimum sea-level pressure near the center of Nancy was estimated to be 992 mb. Nancy crossed the Vietnam coast about 140 mi northwest of Danang during the afternoon of the 22d and degenerated into an area of low pressure over Laos.

Severe tropical storm Mac originated about 500 mi east of Manila early on September 16. It moved westward and intensified into a tropical storm. At 0503 a reconnaissance aircraft reported a minimum sea-level pressure of 995 mb and maximum surface winds of 60 kn near the center. The tropical storm continued to track westward and crossed Luzon on the 18th. The following afternoon it passed about 40 mi southwest of Manila, where maximum winds of only 28 kn were reported. According to press reports, Mac killed two people in the Philippines and left hundreds of people homeless. It also caused damage worth millions of dollars.

Mac had weakened into a tropical depression when

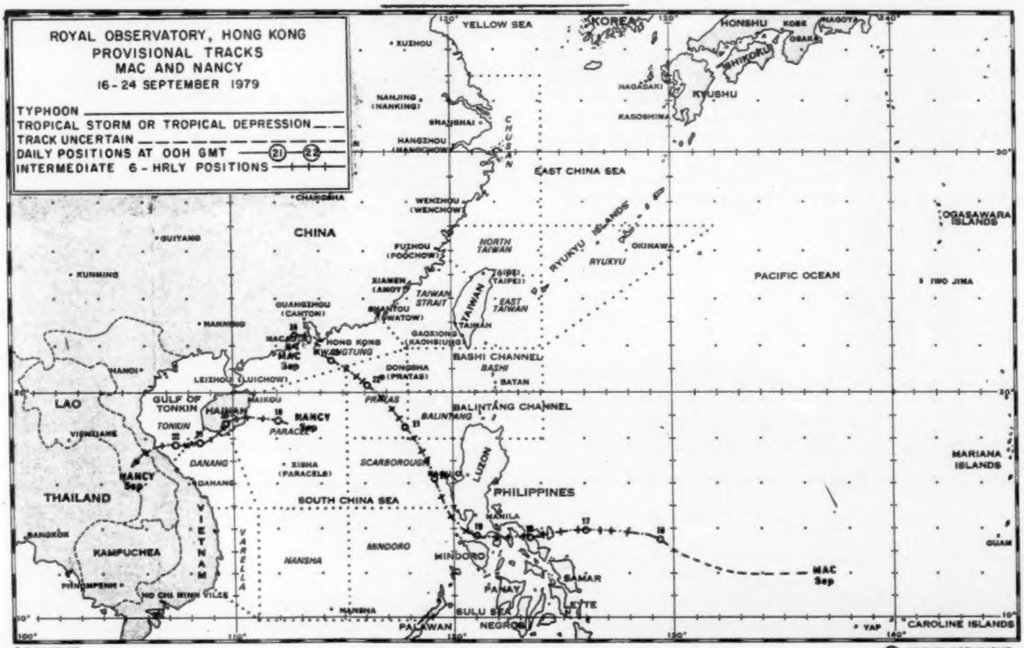

Figure 13.--Tracks of tropical storms Mac and Nancy.

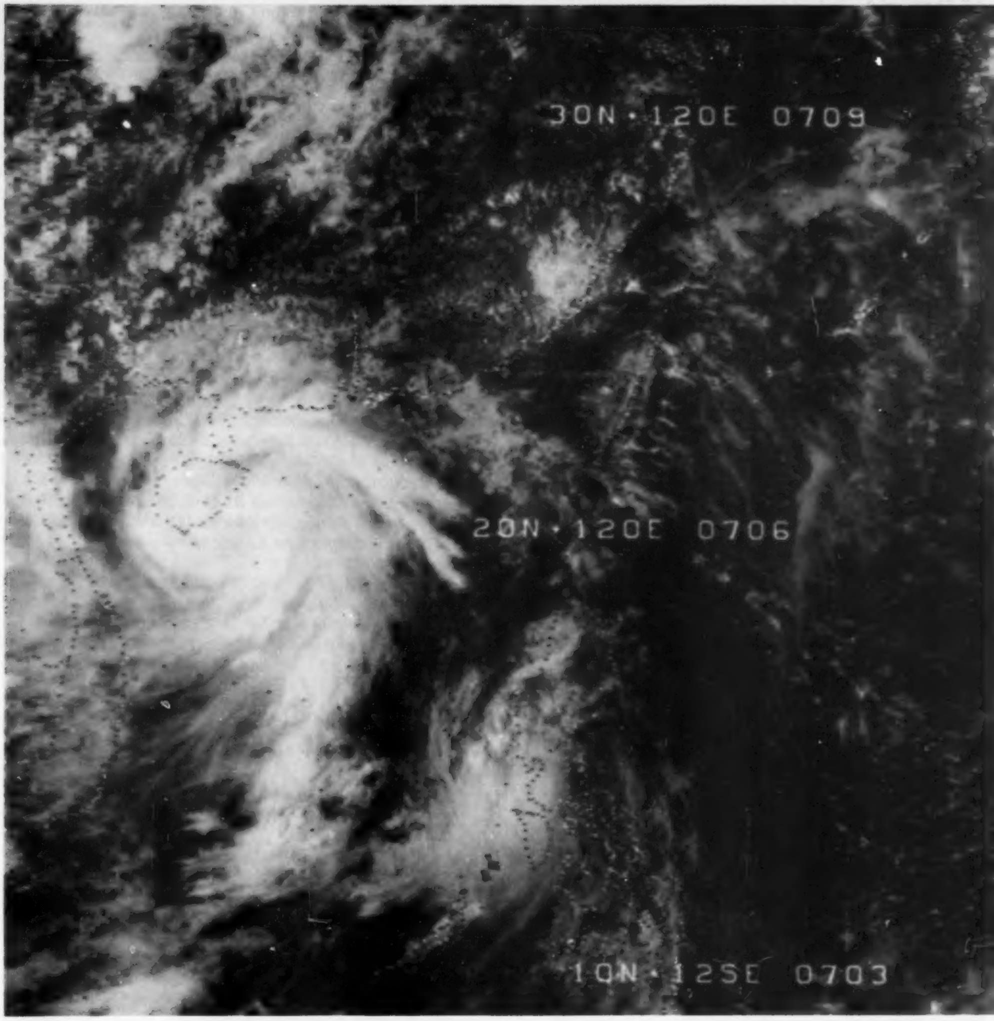

Figure 14.--This satellite photo catches Nancy off Hainan and Mac off Manila Bay early on September 19.

it entered the South China Sea on September 19. Satellite pictures indicated that the cloud bands associated with the circulation of Mac were very disorganized, and the center was difficult to locate. At first the tropical depression moved north-northwestward at about 10 kn, but it gradually changed to a northwesterly course heading directly towards Hong Kong. It came within 400 mi of Hong Kong on September 20.

At this time the Stand By Signal was already hoisted in Hong Kong. Mac continued to track northwestward. Satellite pictures and reconnaissance aircraft reports on September 20 and 21 showed that Mac was still relatively weak. The minimum sea-level pressure reported was 997 mb. Mac passed about 35 mi southwest of Dongsha Dao (Pratas Island) during the morning of the 22d. At 2200 on the 21st there was an unconfirmed report from the Island of 46-kn east-southeasterly winds and a mean sea-level pressure of 997 mb. The center of Mac began to appear on the Royal Observatory's weather radar, which showed that although there was no eye, there were heavy rain bands to the east of the center.

In Hong Kong winds gradually freshened from the northeast early on the 22d. The Strong Wind Signal, No. 3, was hoisted at 0345 when Mac was centered about 150 mi away. Mac moved northwestward at

about 7 kn towards the estuary of Zhu Jiang (Pearl River) overnight on the 22d and intensified rapidly. The KWANGSI reported 37-kn winds about 90 mi southeast of the center at 2100 on the 22d, and 3 hr later the LARISAREYSNER reported 34-kn winds about 65 mi south-southwest of Mac.

Mac reached severe tropical-storm intensity early on the 23d. Radar echoes near the center reached a height of 16,750 m. The Northeasterly Gale or Storm Signal, No. 8NE, was hoisted at 0110, when Mac was 55 mi to the south-southeast. This was followed by the Southeasterly Gale or Storm Signal, No. 8SE, at 0615 when the center was 45 mi south-southwest of Tate's Cairn. Mac probably reached maximum intensity at this time. The minimum central pressure was estimated to be around 990 mb and the maximum winds around 60 kn. Mac slowed down considerably later in the afternoon and began to drift slowly northward, still coming closer to Hong Kong. After passing over western Lantau Island around midnight, Mac turned westward and headed toward Macau. Winds over Hong Kong quickly abated, and the Southeasterly Gale or Storm Signal was replaced by the Strong Wind Signal at 45 min past midnight when Mac was centered about 25 mi west of Tate's Cairn. Mac was closest to Hong Kong around 1:00 a.m. local time, but by this time pressure at the Royal Observatory had risen to 1003.4 mb and the estimated central pressure of Mac to 995 mb. The lowest pressures recorded were 1001 mb at 1200 at the Royal Observatory and 997.3 mb at 1400 at Chek Lap Kok.

Overnight Mac passed just north of Macau where a minimum sea-level pressure of 995.3 mb was reported. The maximum wind reported there was 30 kn with gusts to 47 kn. Mac weakened rapidly overland, and all signals were lowered in Hong Kong at 2215 on September 23, when Mac was about 70 mi due west of Hong Kong. Mac degenerated into an area of low pressure north of Shangchuan Dao (St. John's Island) during the afternoon of September 24.

In Hong Kong winds were moderate to fresh easterly on September 19 to 21. However, as Mac approached, winds freshened from the northeast early on the 22d and became strong later in the day. Apart from the urban areas, gales were experienced in many locations on the 23d. Winds turned southeasterly late in the afternoon and gradually moderated during the evening. Maximum winds and gust peak speeds recorded at various locations are given in table 2.

It was cloudy with some showers on September 19 and 20, but the following 2 days were mainly fine. Showers began to set in overnight on the 22d, and widespread heavy rain was experienced the following day. Rain was very heavy between 0400 and 1100, when the Royal Observatory recorded a total rainfall of 202.1 mm. Heavy rain was again experienced on the evening of the 25th, probably resulting from the passage of a trough of low pressure associated with the remnants of Mac which drifted back through Hong Kong. The daily amounts of rainfall recorded at the Royal Observatory were as follows:

Table 2.--Maximum winds and peak gusts during tropical storm Mac

Location	Maximum mean hourly wind (kn)		Maximum gust (kn)	
Royal Observatory	E	28	ENE	71
Hong Kong Airport (SE)	E	36	E	66
Waglan Island	E	64	E	80
Tate's Cairn	E	42	E	80
Cheung Chau	ESE	48	ESE	68
Star Ferry	E	32	E	57
Green Island	ENE	36	ENE	52
Tsim Bei Tsui	NE	22	--	--
Chek Lap Kok	E	49	ESE	66
Stanley	NE	64	NE	79
Tai O	NNE	40	NNE	62

September 19	7.9 mm
September 20	5.3 mm
September 21	7.2 mm
September 22	trace
September 23	243.7 mm
September 24	9.0 mm
September 25	13.8 mm
September 26	94.8 mm
September 27	nil
Total	381.7 mm

Mac caused the death of 1 person, and 67 people were injured mostly by flying debris and falling objects. More than 300 people sought refuge in typhoon shelters. All public transport except the Kowloon-Canton Railway was suspended shortly after midday on September 23. Air flights were cancelled or delayed, and 25 aircraft were diverted from Hong Kong. Many roads were flooded by the heavy rain, and several landslides occurred. A cargo ship dragged anchor at Kellet Bank, and another one broke her cables but was safely anchored later. Tides were about 0.5 m above normal around noon on September 23, but no reports of flooding from the sea were received.

This is a provisional report.

Mariners Weather Log

HIGH WAVES IN THE BENGUELA CURRENT

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An examination of the U.S. Navy Marine Climatic Atlas of the World, Vol. 4, South Atlantic Ocean (U.S. Navy, 1978) reveals that there was a sharp, persistent wave height anomaly in the midst of the Benguela Current. Because the high frequency of high waves (and correspondingly low frequency of low waves) coincided so well with the frequency of observations, it was at first feared that some program bug or observational bias had contaminated the charts. Careful inspection of the data, however, confirmed that the program had no bugs and that the axis of maximum data coverage (corresponding to the central shipping lane) was at times slightly different from the high-wave axis. Further correlation with other areas and consideration of the physical dynamics of the problem led to the conclusion that neither data biases nor program errors were to blame. The anomaly was real.

It is recognized that there are certain systematic biases in the visual wave data set: heights are about 10 to 15 percent too low, and directions favor the 8 and 16 compass points. But these have relatively little bearing on the Benguela wave phenomenon.

Maps of the wave height regime off southwest Africa are shown in figures 15 and 16. Isopleths are presented for the months of February, May, August, and November, representing the austral seasons of summer, fall, winter, and spring, respectively. The higher of sea or swell height was used when multiple wave-trains were reported. The small rectangular areas inset on the maps are the areas for which tabular-graphical summaries are presented in figures 17 and 18 (also adapted from U.S. Navy, 1978). Note the similarity between wind and wave data, implying at a glance that a significant portion of the wave regime may be locally wind-driven. An outline of the approximate location of the Benguela Current is included in figure 19a.

Of particular interest in figure 16 is the continued existence of the phenomenon for wave heights ≥ 6 m. The winds from larger storms which generate those high waves appear to be reinforced by the same mechanisms that reinforce the day-to-day general circulation.

The extremely narrow, well-defined nature of the phenomenon is apparent in figures 15 and 16. Very

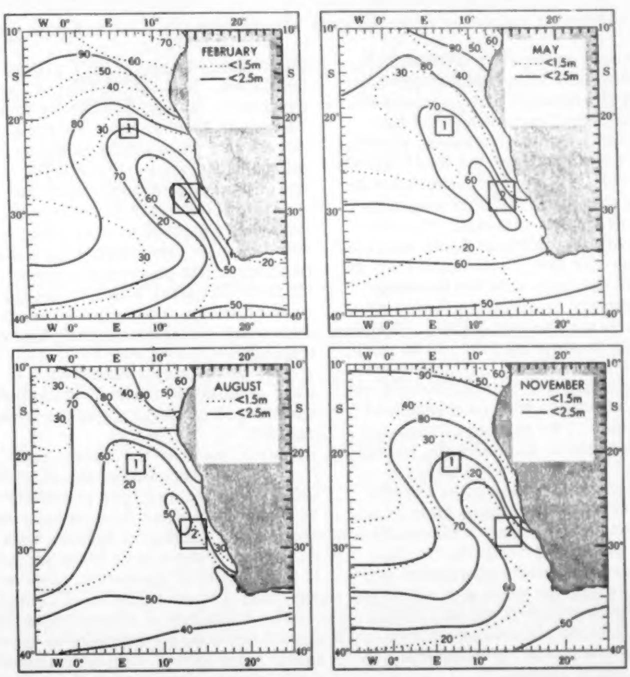


Figure 15.--Percent frequency of low (<1.5 m) and low-to-moderate (<2.5 m) waves.

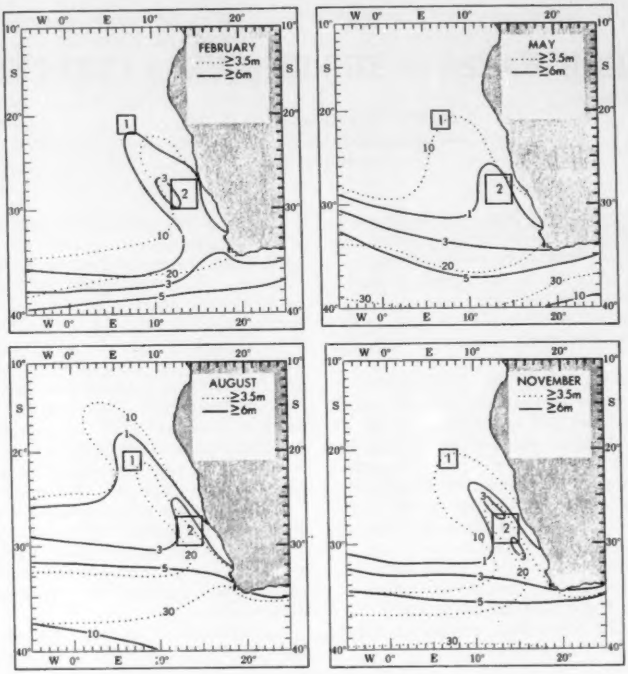


Figure 16. --Percent frequency of moderately high to high (≥3.5 m) and high (≥6 m) waves.

few other areas of the world ocean show a climatological macroscale wave structure with such sharp, regular gradients. Areas in the Arabian and Tasman Seas do have fairly spectacular local anomalies, but have been covered somewhat better in the literature than the Benguela anomaly. We have examined the South Pacific area, particularly near the Chilean coast where a similar phenomenon may be expected, but data coverage is too poor to provide a definitive analysis. We suspect that the orientation of the southwest South American coast and the absence of a large land mass with its attendant thermal low are not favorable for development of as distinct an anomaly as along southwest Africa, but we will have to await hindcast models, buoys, satellite data, or a change in shipping lanes to be sure.

When the anomaly was first noticed by the authors, a search was made for reference to it in the literature. Several references were checked, with no mention of the phenomenon being found. Two earlier atlases examined had no direct indication of the anomaly, but did contain some generalized data analyses that gave a qualitative indication of the phenomenon after careful postanalysis. In a 1951 article, O. Jessen hints at it very indirectly, but is concerned mainly with southwest swells near coastal areas and "rollers." So-called "rollers," southwesterly swells of gigantic proportions, often inflict their damage when opposition to the Agulhas Current metamorphoses them into "freak waves" or when they break along shorelines. They are a completely separate phenomenon, originating as swells from migratory oceanic storms.

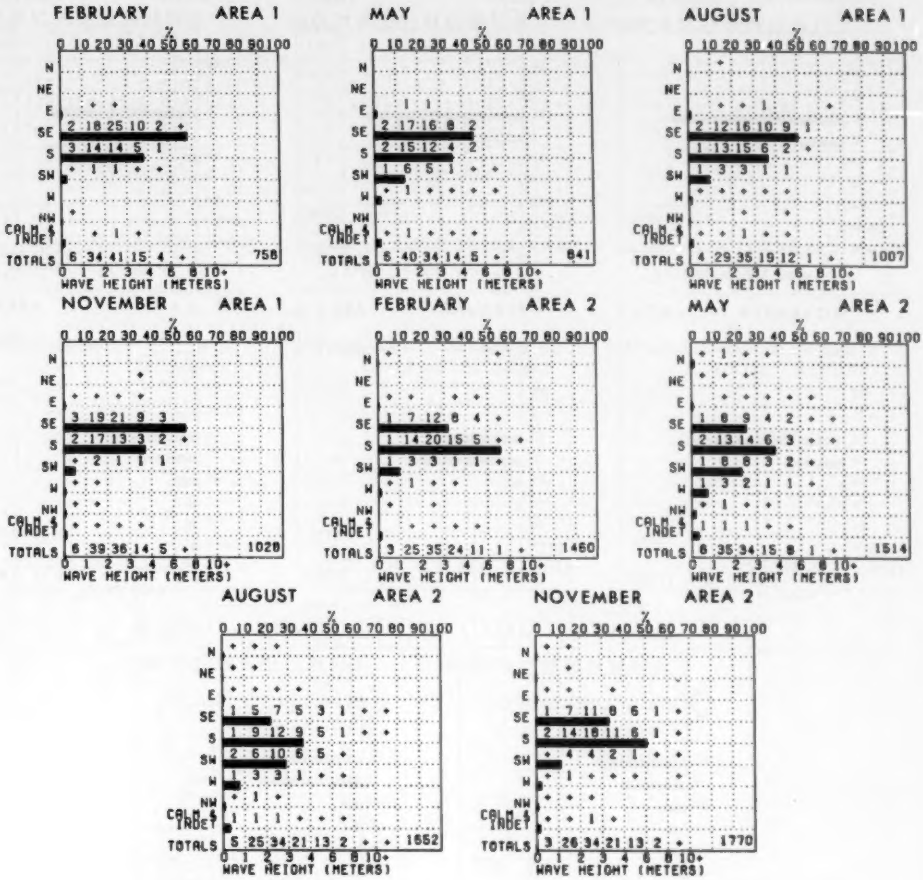
The U.S. Pilot Charts show no indication of the Benguela anomaly as yet, but will as future updates are published. Sailing Directions, also frequently used by mariners, do not specifically mention this phenomenon. The older Marine Atlas series contain no wave data, but clearly show a part of the oceanic forcing mechanisms in the wind and pressure charts. A German atlas of the South Atlantic contains similar information.

The "Mariners Bible" (Bowditch, 1977) could not really be expected to carry this sort of information, and does not. Bowditch does point out that waves are heightened and steepened when winds oppose ocean surface currents, which is not the case in the Benguela wave anomaly, where the waves follow the winds. This makes the sharpness of the phenomenon even more intriguing.

One of the major difficulties in finding the Benguela wave anomaly in much of the earlier literature is the coarseness of the grids used--usually 10° or 20° quadrangles.

In all, we are not necessarily claiming to be the first to have recognized the existence of this phenomenon--detailed analyses of earlier works could have revealed it to other researchers. And surely seafarers frequenting southwest African waters must have sensed it. But as yet we have found no specific references to it in the general literature, even in some fairly esoteric sources, and certainly no quantitative descriptions.

The existence of a wave anomaly off southwest Africa should come as no surprise to anyone perusing the climatic references. One of the earliest atlases, while containing no direct wave data, distinctly shows a region of high average winds of high constancy over the Ben-



Wave direction and height.

Direction frequency (top scale): Bars represent percent frequency of waves from each direction.

Height frequency (bottom scale): Printed figures represent percent frequency of wave heights observed from each direction.

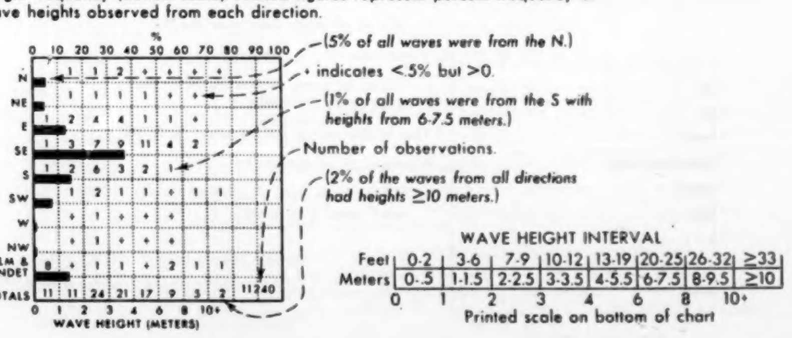
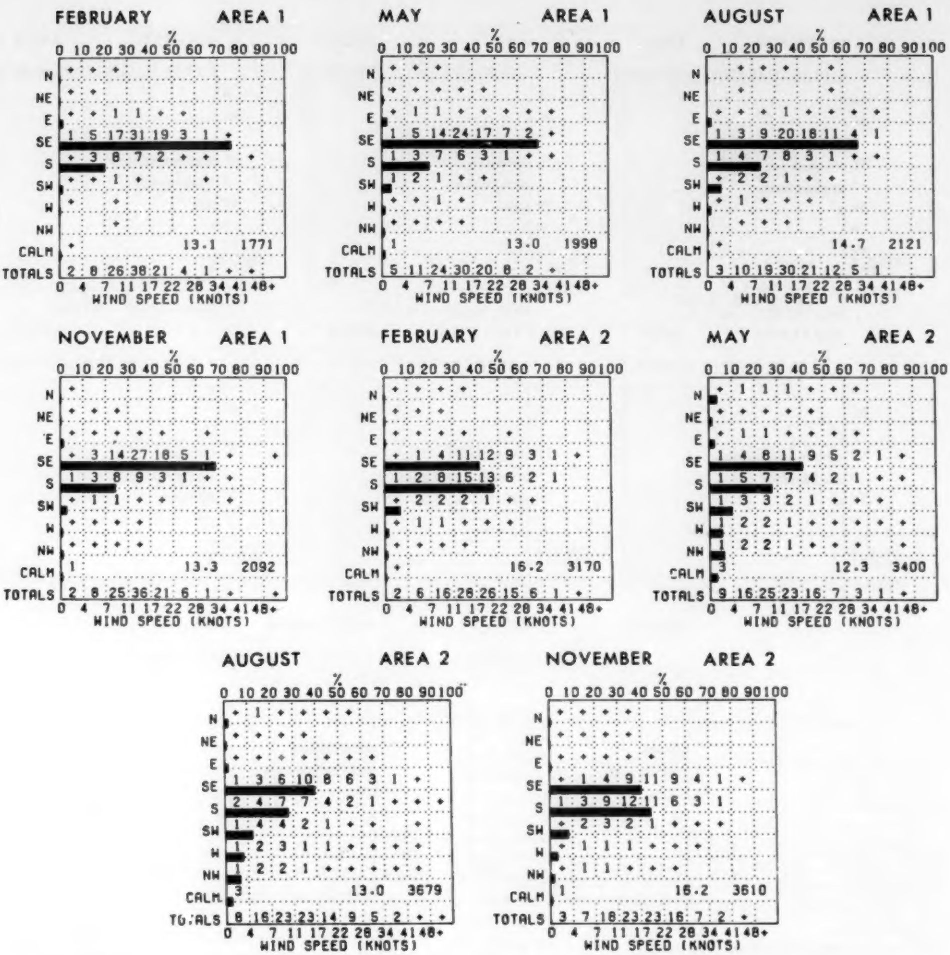


Figure 17a. --Wave height versus direction.



Direction frequency (top scale): Bars represent percent frequency of winds observed from each direction. Speed frequency (bottom scale): Printed figures represent percent frequency of wind speeds observed from each direction.

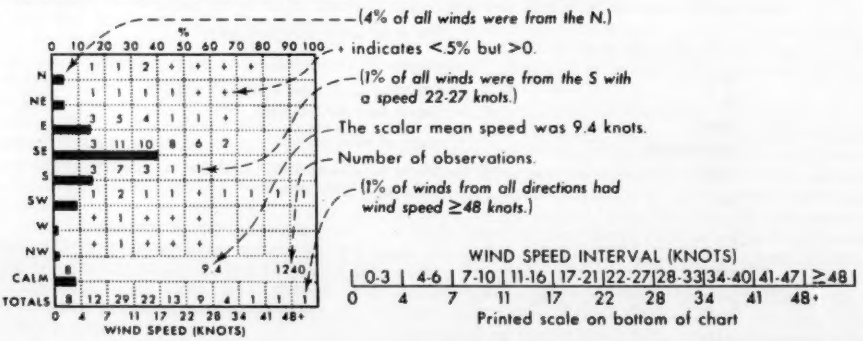


Figure 17b. --Windspeed versus direction.

FEBRUARY — AREA 1

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	5	1	+	+	0	0	1
1-1.5	14	10	4	1	1	+	4
2-2.5	8	14	10	3	1	1	4
3-3.5	1	5	6	2	+	+	1
4-5.5	+	1	2	+	+	+	0
6-7.5	0	+	+	0	0	0	0
8-9.5	0	0	0	0	0	0	0
≥10	0	0	0	0	0	0	0

763

MAY — AREA 1

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	4	+	1	0	0	0	1
1-1.5	11	13	7	3	2	1	4
2-2.5	5	11	8	4	2	2	2
3-3.5	1	4	4	3	1	+	1
4-5.5	+	1	2	1	+	+	+
6-7.5	0	0	+	0	0	+	0
8-9.5	0	0	0	0	0	0	0
≥10	0	0	0	0	0	0	0

845

AUGUST — AREA 1

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	3	+	+	0	0	0	1
1-1.5	10	11	4	1	1	+	3
2-2.5	6	9	10	5	1	1	2
3-3.5	2	3	6	3	2	1	2
4-5.5	1	2	4	2	1	+	+
6-7.5	0	+	+	+	0	+	0
8-9.5	0	0	+	0	0	0	0
≥10	0	0	0	0	0	0	0

1018

NOVEMBER — AREA 1

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	4	1	+	0	0	0	1
1-1.5	13	13	6	1	1	1	4
2-2.5	7	13	7	3	1	1	3
3-3.5	2	4	5	1	1	+	1
4-5.5	+	1	2	1	+	+	+
6-7.5	0	0	+	0	0	0	0
8-9.5	0	0	0	0	0	0	0
≥10	0	0	0	0	0	0	0

1032

FEBRUARY — AREA 2

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	2	+	0	+	0	0	1
1-1.5	9	7	4	1	1	+	4
2-2.5	6	12	9	3	1	+	3
3-3.5	2	8	7	3	1	1	2
4-5.5	1	3	4	1	1	+	1
6-7.5	0	+	+	0	+	0	0
8-9.5	0	0	0	+	0	0	0
≥10	0	0	0	0	0	0	0

1466

MAY — AREA 2

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	4	+	+	+	0	0	2
1-1.5	9	12	7	2	1	1	4
2-2.5	5	9	9	5	2	1	3
3-3.5	1	5	5	3	2	+	1
4-5.5	1	1	3	2	1	+	+
6-7.5	0	+	+	+	+	+	+
8-9.5	0	0	+	0	0	0	0
≥10	0	0	0	0	0	0	0

1530

AUGUST — AREA 2

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	3	1	+	+	0	0	2
1-1.5	9	8	3	1	1	+	3
2-2.5	4	8	9	5	2	1	4
3-3.5	1	6	6	4	2	1	1
4-5.5	+	2	5	3	2	1	1
6-7.5	0	+	+	+	+	+	+
8-9.5	0	+	+	0	0	0	+
≥10	0	0	+	0	0	0	0

1673

NOVEMBER — AREA 2

PERIOD (SECONDS)

HEIGHT (MTRS)	<6	6-7	8-9	10-11	12-13	>13	IND
0-.5	2	+	+	+	0	0	1
1-1.5	9	8	3	2	1	+	4
2-2.5	7	10	8	4	2	1	3
3-3.5	2	8	5	2	1	1	2
4-5.5	1	4	4	2	1	+	1
6-7.5	0	1	+	+	+	+	0
8-9.5	0	0	+	+	0	0	0
≥10	0	0	0	0	0	0	0

1774

PERIOD (Seconds)

HEIGHT MTRS	≤6	6-7	8-9	10-11	12-13	>13	IND
0-.5	21	3	1	+	+	+	6
1-1.5	22	16	6	2	1	+	+
2-2.5	3	6	4	3	1	+	+
3-3.5	+	1	1	1	1	+	+
4-5.5	+	+	+	+	+	+	0
6-7.5	0	+	+	0	0	+	0
8-9.5	0	0	0	+	0	0	0
≥10	0	0	0	0	0	+	0

4010

Percent frequency of occurrence of wave period and height.

(2% of observed waves had a height of 1-1.5 meters and a period of 10-11 seconds.)

+ indicates <.5% but >0.

Number of observations.

Waves are selected on the basis of the higher of sea and swell when both are reported. If both heights are equal, the wave with the longer period is selected.

Figure 18. --Wave height versus period.

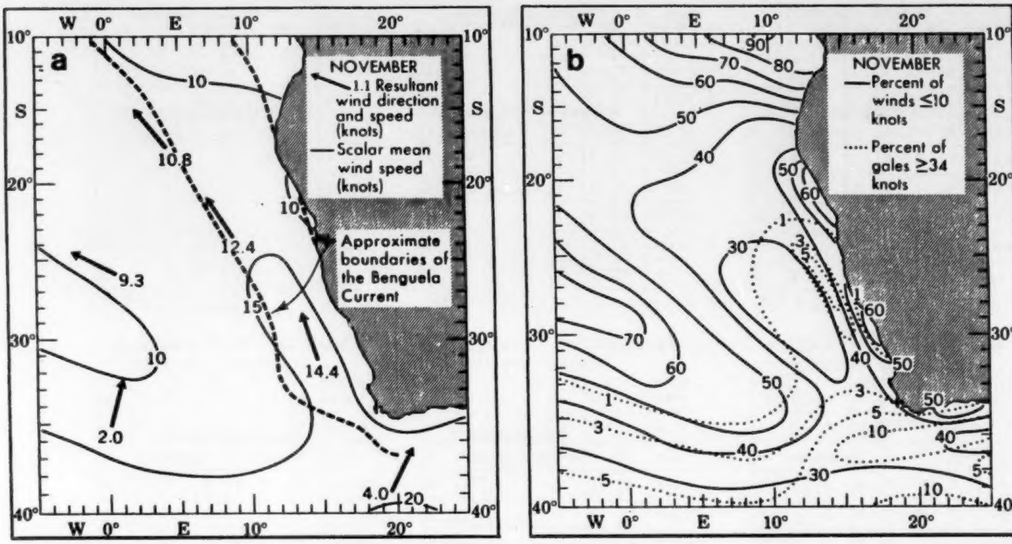


Figure 19. --Wind regime, November. Figure 19a also depicts the Benguela Current area representative for all months.

guela Current. Constancy is the ratio of vector resultant mean wind magnitude to scalar mean wind. As the vector resultant mean wind magnitude divided by the scalar mean wind approaches 1, it means decreasing variability in wind direction. More recent references have verified this high wind regime. Figure 19, abstracted from the U.S. Navy Marine Climatic Atlas of the World, Vol. 4, South Atlantic Ocean, clearly shows the wind patterns. The relatively high gale frequencies in the area are consistent with the high waves shown in figure 15. Although only the transitional month of November is shown, similar patterns persist throughout the year.

The driving mechanism for the steady high winds is the semipermanent South Atlantic Ocean subtropical high-pressure area. A climatological November mean pressure map is shown in figure 20. Subtropical highs are extremely persistent features of the general circulation. The eastern portions of these high-pressure systems are observed to be marked by subsidence, high stability, and steady winds. Augmenting these effects in the case of southwest Africa are the following:

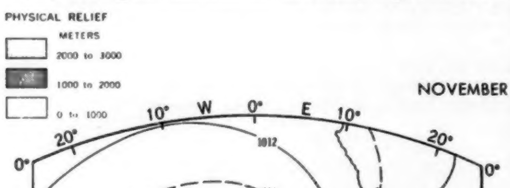


Figure 20. --Mean sea-level pressure pattern (mb), November.

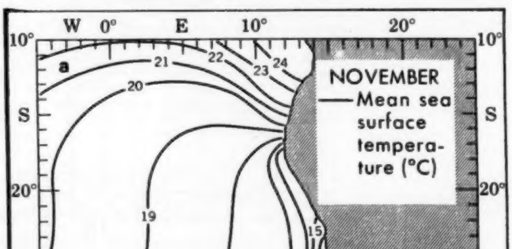


Figure 21. --Mean sea-surface temperature (°C), November.

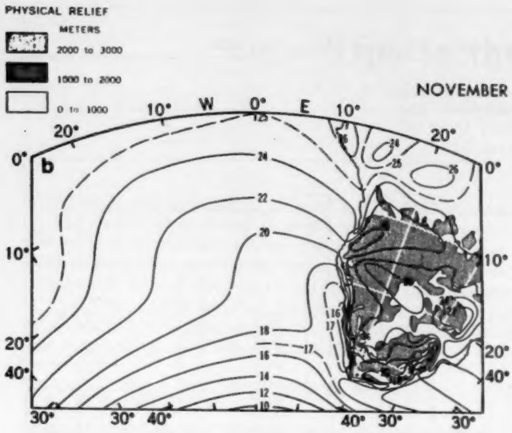


Figure 22.--Mean surface air temperature (°C), November.

• A high plateau on the continent effectively cuts off zonal flow and channels the winds along the axis of the Benguela Current.

• A thermal low over the continent intensifies the pressure gradient along the coastal area and hence intensifies the winds. The nature of this pressure system was poorly depicted in most earlier works, but is clearly shown in figure 20.

• Coastal upwelling, which results from the longshore (equatorward) component of wind and the Coriolis effect, causes cold sea-surface temperature and hence cold surface air temperature. This cold, relatively dense air offshore helps maintain a strong pressure gradient and hence strong winds. The high degree of stability, resulting from cool air near the surface, helps maintain the steady direction of the surface flow. Figures 21 and 22 illustrate this feature, which persists throughout the year.

The stable air is reflected in other elements as well, such as low precipitation frequencies and clear skies. While all of these features are apparent in the climatic analyses, their regularity on a day-to-day basis also becomes evident when reviewing a series of consecutive daily weather maps.

ACKNOWLEDGMENTS

The authors express their thanks to the U.S. Navy for support and to many National Climatic Center and National Oceanographic Data Center staff members for their helpful suggestions.

Appreciation is expressed to the Journal of Physical Oceanography, where this article was published in Volume 9, July 1979.

Hints to the Observer

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SEA AND SWELL PERIOD AND DIRECTION

The wave observation is among the most difficult and complex in the International Ship Weather Code. It is also one of the most important elements, since wave forces on ships, structures, and the beach are among the most important engineering considerations that require actual data for planning and design.

In situ wave measurements by instruments have shown that wave-height data from nearby merchant ships are highly reliable. Direction is also reported well, but there is some bias to the compass points. The most significant problems seem to be with period. Wave period is the time interval between the passage of two successive crests of the same wave train past a fixed point.

Reporting of swell direction in tens of degrees (essentially a 36-point code) has been common practice for many years. Orders to the helmsman and entries of ship's course in the log have been expressed in degrees rather than compass points for an even longer period of time. When estimating bearings, however, the use of 8-, 16-, and 32-point systems persists and has resulted in a notable bias in the reporting of swell directions. In figure 23 the 8-point bias is evident. A 16-point bias is present to a lesser but still significant extent--note that all 16-point frequencies are higher than their adjacent frequencies.

The most common error in wave period appears to be underestimation. A comparison of some different wave-period data for an area near Virginia Beach is shown in figure 24. The details of this study are not important here. Of primary significance are the low values of wave period derived from ship observations (including light ships). It is suspected that the low values of period resulted from confusion of wave trains and some degree of miscoding.

Underestimating period is understandable when we consider that many wave trains are generally present at the same time. When timing the passage of a wave train, it is important that the foam, floating object, or other reference be followed from crest to crest of the same wave train. If the period is measured incorrectly from the crest of one wave train to the crest of an intervening wave from another wave train, then the result will be a period that is too short.

Since measurement is complex and coding difficult to remember, the rules and code tables from Weather Service Observing Handbook No. 1 are reproduced here for review.

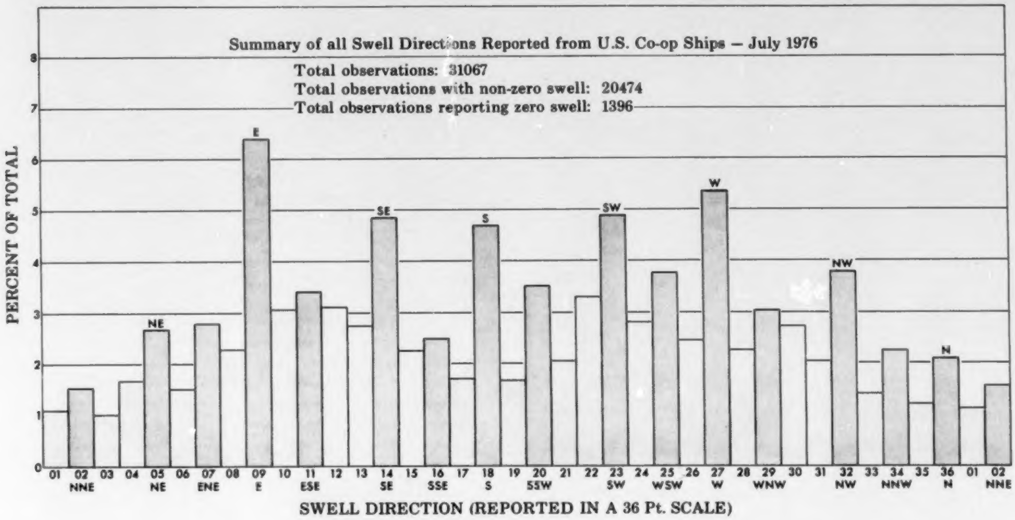


Figure 23. -- A histogram of reported swell direction by tens of degrees. Note the 8- and 16-point bias.

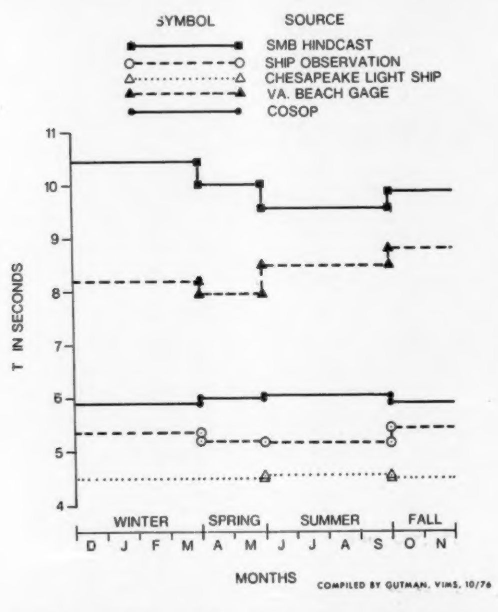


Figure 24. --Average significant wave period by season as obtained from various sources for comparison.

Wave Period. To determine the period of wind waves or swell, select a distinctive patch of foam or a small floating object at some distance from the ship. As the object falls astern select a new one. Note the elapsed time to the nearest second between the moments when the object is on the crest of the first and of the last well-formed wave in the group. Also note the number of crests that pass under the object during the interval. Continue the observation until at least 15 waves have been timed. Add the elapsed times of the various groups together and divide the total by the number of waves to obtain the average period.

Period of Wind Waves in Seconds ($P_W P_W$). Example: 05 = 5 seconds, 12 = 12 seconds, etc. (The code figure 00 is used when no waves are observed due to a calm sea. The code figure 99 is used when estimation of the wave period was impossible owing to a confused sea. Solidi (//) are used when the wave period is not observed for any other reason.)

Period of Swell Waves (P_W)

Code Figure	Period	Code Figure	Period
0	10 seconds	5	5 seconds or less
1	11 seconds	6	6 seconds
2	12 seconds	7	7 seconds
3	13 seconds	8	8 seconds
4	14 seconds or more	9	9 seconds
		/	Calm, or period not determined

Tips to the Radio Officer

Thomas H. Reppert
National Weather Service, NOAA
Silver Spring, Md.

WEATHER BROADCASTS FOR SOUTHEAST ALASKA

The U.S. Coast Guard is now broadcasting weather and notices to mariners from the Althorp Peak remote VHF-FM site located on the south side of Cross Sound. Broadcasts are at 0503 and 1703 GMT on Channel 22 (157.1 MHz). The weather broadcast consists of small craft advisories, gale and storm warnings, and the coastal forecast from Cape Fairweather to Cape Sukling.

GREAT LAKES ICE INFORMATION

The Great Lakes Ice Outlook and Ice Forecast prepared by the National Weather Service are broadcast by the following Coast Guard radio facilities on Channel 22 (157.1 MHz).

Group	Outlook	Forecast
Sault Ste. Marie	1850Z	0005Z
Detroit	1655Z	2255Z
Duluth	1635Z	2235Z
Milwaukee	1755Z	2255Z
Buffalo	1755Z	2355Z

The Ice Outlook covers general weather and ice trends for a 3- to 5-day period. The Ice Forecast is more specific and includes wind, temperature, and weather as well as ice conditions through 7:00 p.m. EST the following day. An Ice Summary of observed ice conditions throughout the Great Lakes is prepared by the Ice Navigation Center at Cleveland and may be requested from the nearest Coast Guard unit or by radiotelephone or Channel 16. The Ice Navigation Center may also be reached by Telex 980-145 or telephone (216) 522-4420.

CORRECTIONS TO WORLDWIDE MARINE WEATHER BROADCASTS (JANUARY 1979 EDITION)

Page 23
1-1140 Manila, Philippines DZO
Delete freq. 12870; insert 12894.

Page 25
1-1290 Papeete, Tahiti FXP
Delete station.

Page 29
1-1610 Ras Tannurah, Saudi Arabia HZY
Change times to 0430, 0800.

Page 59
2-1730 Durban, South Africa ZSD
Delete freq. 8744.8; insert 8740.6.
Delete freq. 4377.4; insert 4376.

Page 66
3-0190 Rota, Spain AOK
Area: 60°N 30°W, 60°N 60°E
20°N 10°W, 20°N 35°E
Frequency (KHz): 7626, 12184
0000, 1200 Broadcast schedule
0028, 0220 Surface analysis
0948, 1228
1420, 2148

New station:
3-0240 Athens, Greece NGR
Area: 60°N 30°W, 60°N 60°E
20°N 10°W, 20°N 35°E
Frequency (KHz):
5206 2000-0800
8100 H24
12903 0800-2000

0000, 1200 Broadcast schedule
0028, 0220 Surface analysis
0948, 1228
1420, 2148

Page 68
3-0300 Pretoria, South Africa ZRO
Revise as follows:
4014 1730-0300
7508 H24
13773 0300-1730
18238 0545-1745

0515, 1000, 1445 Surface analysis
0920, 1820 Surface prognosis

Page 77
4-0040 Mobile, Alabama WLO
Area: (a) Southwest North Atlantic
(b) Caribbean Sea
(c) Gulf of Mexico
(d) Eastern Pacific area Alfa (Equator to 30°N, east of 140°W) and area Bravo (north of 30°N and east of 160°E)
Frequency (KHz):
4352.0 8707 13073.5
17209.5 22588

1130, 1730, 2330 Forecasts and warnings, Gulf of Mexico, Loop Current

Hurricane Alley

Dick DeAngelis
Environmental Data and Information Service, NOAA
Washington, D.C.

TROPICAL CYCLONE WATCH - 1979

Tables 3 and 4 below tabulate world tropical-cyclone activity from January through December 1979. These statistics are preliminary, but do give an idea as to current tropical-cyclone activity. The month is the month in which warnings were first issued; after final analysis the month could change if the storm formed at the end of the preceding month. The figures in parentheses represent those tropical storms that have reached hurricane or typhoon strength.

Table 3.--Tropical cyclone watch, 1979

Month	North Atlantic	Western North Pacific	Eastern North Pacific	North Indian	South Indian	Australia-South Pacific	World Total
January		1(1)			1(1)	3(1)	5(3)
February					3(1)	4(1)	7(2)
March		1(1)			3	2(2)	6(3)
April		1(1)			3(1)	1	5(2)
May		1	1(1)	1(1)			3(2)
June	1		1	1			3(0)
July	2(1)	4(2)	2(1)				8(4)
August	3(2)	2(2)	2(2)		1		8(6)
September	2(2)	6(2)	1	2	1		12(4)
October		3(2)	2(1)	1			6(3)
November		2(1)	1	2	1(1)		6(2)
December		2(1)			2(1)	1	5(2)

NORTH INDIAN OCEAN
SEPTEMBER AND OCTOBER 1979

The second season began right on time with the development of two tropical storms in September--one in each basin. Another tropical storm popped up in the Bay of Bengal in late October.

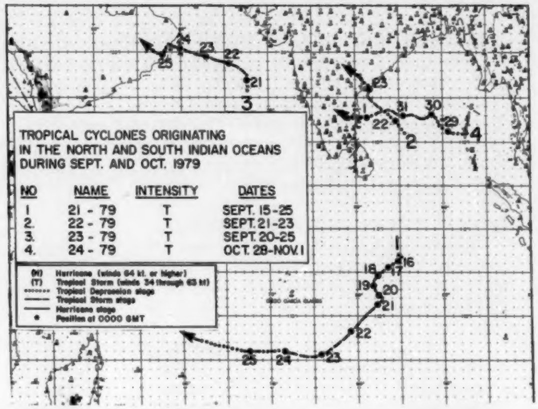


Figure 25.--Tracks of tropical cyclones in the North and South Indian Oceans, September and October 1979.

Both September cyclones formed about the same time (fig. 25). Arabian Sea storms are most likely in October and November, although they are not unusual in September. It is unusual though for one to reach the Saudi Arabian Peninsula. In Salalah, Oman, annual rainfall averages about 4.5 in, with an average September fall of less than .2 in. This September they

Table 4. --World tropical cyclone watch, 1979

North Atlantic		
Ana	TS	June
Bob	H	July
Claudette	TS	July
David	H	Aug.
Elena	TS	Aug.
Frederic	H	Aug.
Gloria	H	Sept.
Henri	H	Sept.

Eastern North Pacific		
Andres	H	May
Blanca	TS	June
Carlos	TS	July
Dolores	H	July
Enrique	H	Aug.
Fefa	H	Aug.
Guillermo	TS	Sept.
Hilda	TS	Oct.
Ignacio	H	Oct.
Jimena	TS	Nov.

Western North Pacific		
Alice	TY	Jan.
Bess	TY	March
Cecil	TY	April
Dot	TS	May
Ellis	TY	July
Faye	TS	July
Gordon	TS	July
Hope	TY	July
Irving	TY	Aug.
Judy	TY	Aug.
Ken	TS	Sept.
Lola	TY	Sept.
Mac	TS	Sept.
Nancy	TS	Sept.
Owen	TY	Sept.
Pamela	TS	Sept.
Roger	TS	Oct.
Sarah	TY	Oct.
Tip	TY	Oct.
Wayne	TS	Nov.
Vera	TY	Nov.
Abby	TY	Dec.
Ben	TS	Dec.

North Indian		
17-79	H	May
18-79	TS	June
22-79	TS	Sept.
23-79	TS	Sept.
24-79	TS	Oct.
25-79	TS	Nov.
26-79	TS	Nov.

South Indian		
Benjamine	H	Jan.
Celine	H	Feb.
Dora	TS	Feb.
Estelle	TS	Feb.
Gelie	TS	March
Helios	TS	March
Ivan	TS	March
Idylle	H	April
Jane	TS	April
Kevin	TS	April
20-79	TS	Aug.
21-79	TS	Sept.
Albine	H	Nov.
Viola	H	Dec.
Wilf	TS	Dec.

Australia-South Pacific		
Gordon	H	Jan.
Greta	TS	Jan.
Henry	TS	Jan.
Judith	TS	Feb.
Kerry	H	Feb.
Leslie	TS	Feb.
Rosa	TS	Feb.
Hazel	H	March
Meli	H	March
Stan	TS	April
Ofa	TS	Dec.

TS = tropical storm
TY = typhoon
H = hurricane

Figure 26.--Edging close to the Saudi Arabian peninsula on the 22d is tropical cyclone 23-79, while tropical cyclone 22-79 approaches the east coast of India, and 21-79 spins over the South Indian Ocean.

received nearly 4 in--most of it, presumably, from the remnants of this tropical cyclone. Postanalysis of the track may show that the storm actually moved inland farther south than indicated. A few days earlier, on the 22d and 23d, winds near the cyclone's center reached a 60-kn peak (fig. 26).

The Bay of Bengal September storm never reached beyond a minimal tropical storm. This intensity was achieved shortly before the storm moved ashore just north of Kavali on the 23d. The October storm was also a minimum one. After forming among the Andaman Islands, the system moved westward and reached a 35-kn peak on the 30th. However, it dropped to depression strength before moving ashore just south of Madras on November 1.

SOUTHERN HEMISPHERE
SEPTEMBER AND OCTOBER 1979

A preseason tropical storm formed in the South Indian Ocean on the 15th of September (fig. 25). Winds reached a peak on the 22d, when they climbed to about 45 kn. Seas within 60 mi of the center were estimated around 12 ft or more. The following day the system began to weaken. By the 25th it had lost all significant characteristics.

HURRICANE FREDERIC AND EB 42003

The following information was provided by John Snelling and Rob Quayle with drafting by Bob Courtney, all of the National Climatic Center.

When hurricane Frederic was moving to the northwest in the Gulf of Mexico on September 11 and 12, Environmental Buoy 42003 at 26°N, 86°W, was directly in its path (fig. 27). Figure 28 is a graph of regular synoptic reports of pressure, wind, and wave height for the dates and hours shown. Waves were recorded irregularly during the period. The lowest pressure recorded by the Buoy was 959.3 mb at 0200 on the 12th. The highest sustained wind recorded was 66 kn, and the highest wave was nearly 30 ft, both recorded at 0000 on the 12th.

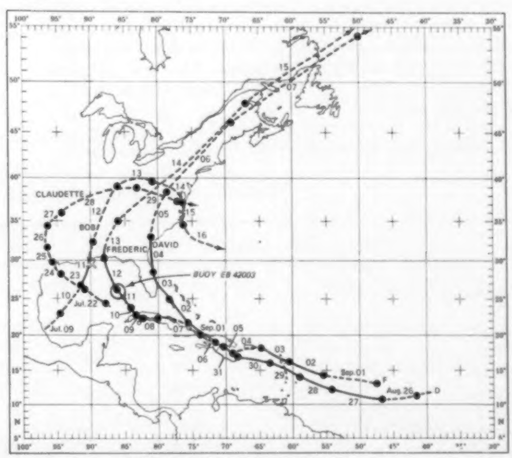


Figure 27.--Tropical cyclone tracks for Bob, Claudette, David, and Frederic.

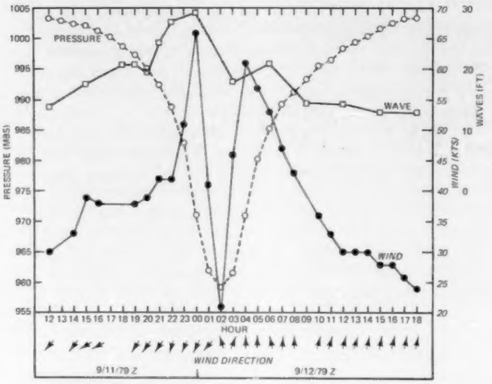


Figure 28.--Wind, wave, and pressure traces as Frederic passed over buoy 42003.

The pattern shown is a classic hurricane passage, with pressures dropping precipitously, then rising in nearly a mirror image. The northeasterly winds built to their highest speed in advance of the center (as the movement of the storm reinforced their strength), dropped to moderate breezes in the eye, then veered abruptly to the south with renewed, near-hurricane force. The waves built in advance of the storm, then began a gradual, irregular decay.

NORTH INDIAN OCEAN TROPICAL CYCLONES 1975 AND 1976

The following summaries are based on articles in the Indian Journal of Meteorology, Hydrology and Geophysics. The 1975 article was authored by George Alexander, V. Srinivasan, and R. Jambunathan. In 1976 P.S. Pant and R. Ramakrishnan replaced George Alexander.

In 1975 seven tropical cyclones (tropical storms and hurricanes) developed in the North Indian Ocean (fig. 29). Three of these became hurricanes. Two of them, both hurricanes, roamed the Arabian Sea, while the rest traversed the Bay of Bengal. This was about an average year (table 5). Table 6 summarizes the activity for the year.

One of the outstanding features of this season was the Arabian Sea hurricane that crossed the Gujarat coast (northwest India) near Porbandar on October 22. The system remained intense inland to the Jamnagar-Raikot area. Rain was widespread and heavy. Amounts ranged from 4 to 10 in. Jamnagar reported windspeeds gusting to 97 kn, while Porbandar recorded 60-kn gusts. Porbandar reported a low pressure of 972 mb. Along the coast swells of 15 to 20 ft were reported. Loss of life was estimated at 85 with considerable damage to houses and crops.

In 1976 10 tropical cyclones developed over the North Indian Ocean (table 7). Of these, four reached hurricane strength (fig. 30). Most of the seven systems that developed in the Bay of Bengal could be traced back to disturbances from the South China Sea or southwestern North Pacific. Cyclone damage was heaviest in parts of Gujarat State, Gangetic West Bengal and Andhra Pradesh. The December hurricane that hit the Bay islands was a rare occurrence and established some record rainfall amounts.

The Mahuva cyclone of late May, early June developed along the leading edge of the advancing monsoon. It reached hurricane strength on the 2d. The HAKON MAGNUS reported 90-kn sustained winds gusting to 110 kn in swells near 50 ft early on the 2d, while the SHENON DAHAY reported at 981-mb pressure with 60- to 80-kn winds. Overland the lowest pressure was 983 mb at Bharnagar on the 3d. About 70 people lost their lives in Gujarat State.

The Contai cyclone in September reached hurricane strength on the 10th and 11th. Reports from Sagar Island and Sandheads indicated winds of 70 to 80 kn; peak gusts climbed to 85 kn on the 11th at Sagar Island, which also recorded a 972-mb pressure. Winds and heavy rains caused considerable damage in the coastal areas of Midnapore, in 24 Parganas districts of West Bengal, and in the northern parts of the Balasore district of Orissa. About 40 people lost their lives. Storm tides of 4 to 6 ft were common. Gaya recorded an all-time record rainfall of 11.4 in on the 16th.

The Masulipatnam cyclone in November was a minimal hurricane (65 kn) as estimated from satellite photos on the 4th and 5th. The cyclone crossed the coast just north of Masulipatnam during the evening of the 4th. The city recorded a 985-mb pressure, while Gannavaram recorded a 55-kn wind. Winds and heavy rains were responsible for crop and property damage, and it was reported that 18 lives were lost.

The December Bay cyclone was churning up 80-kn winds on the last day of the year. The cyclone passed

Table 5.--North Indian Ocean tropical cyclones, 1965-1976

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1965					2(1)						1	3(1)	6(2)
1966				1(1)					2		4(1)	1	8(2)
1967	1				1					3(2)		1(1)	6(3)
1968					1(1)				2(1)	1(1)	2(1)	1	7(4)
1969					1			1		2	1(1)	1	6(1)
1970					2(1)	1			1	1(1)	2(1)		7(3)
1971					1	1			1(1)	2(1)	1	1(1)	7(3)
1972				1(1)			1		2(2)	1(1)	1(1)	1(1)	7(6)
1973						1	1			1	2(1)	1	6(1)
1974				1	2			1(1)	2		1		7(1)
1975					2(2)	1				1(1)	3		7(3)
1976				1	1(1)			1	1(1)	2	3(1)	1(1)	10(4)

Table 6.--North Indian tropical-cyclone summary, 1975

No.	Dates	Max. wind (kn) satellite	Max. wind (kn) reported	Lowest est. pressure (mb)	Lowest observed pressure (mb)
1	May 1-11	80	34 (50 mi)	979	998 (50 mi)
2	May 4-8	85		976	
3	June 4-7	--	45 (close to center)	--	990 (close)
4	Oct. 19-24	90	97 (gusts)	967	972
5	Nov. 1-3		32 (80 mi)		1004 (80 mi)
6	Nov. 7-11	40	32 (100 mi)	998	1001
7	Nov. 24-Dec. 1	60	55 (Madras)	992	

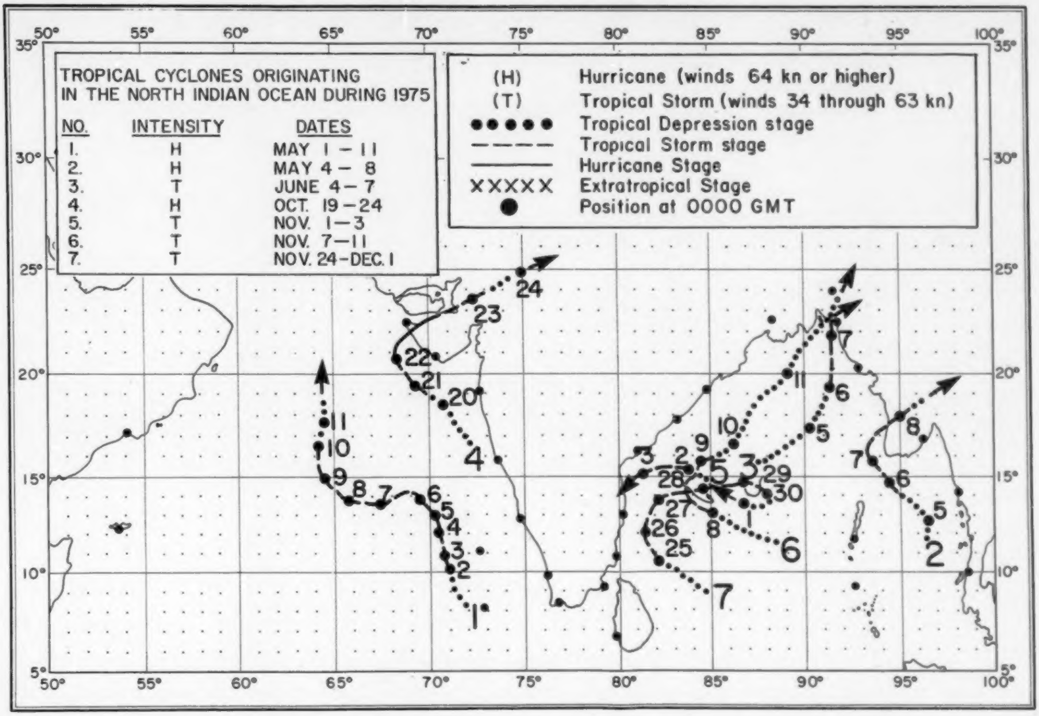


Figure 29.--North Indian Ocean tropical cyclones, 1975.

Table 7.--North Indian tropical-cyclone summary, 1976

No.	Dates	Max. wind (kn) satellite	Max. wind (kn) reported	Lowest est. pressure (mb)	Lowest observed pressure (mb)
1	April 29-May 2	60	50 (Bassein)	986	989 (Sandoway)
2	May 29-June 5	70	90 (ship)	970	981 (ship)
3	Sept. 8-13	70	80 (Sagar Is.)	977	973 (Sagar Is.)
4	Oct. 12-18	55	27 (160 mi)	998	
5	Oct. 15-21	45	45 (25 mi)	994	997 (Hatia)
6	Nov. 3-6	65	55 (Gannavaram)	987	985 (Masulipatnam)
7	Nov. 15-17	60	38 (ship)	992	
8	Nov. 22-29	40	40 (Gannavaram)	1000	
9	Dec. 28-Jan. 3	80	75 (Port Blair)	981	989 (Port Blair)
10	Aug. 27-Sept. 8	40	45 (Okha)	990	990 (Naliya)

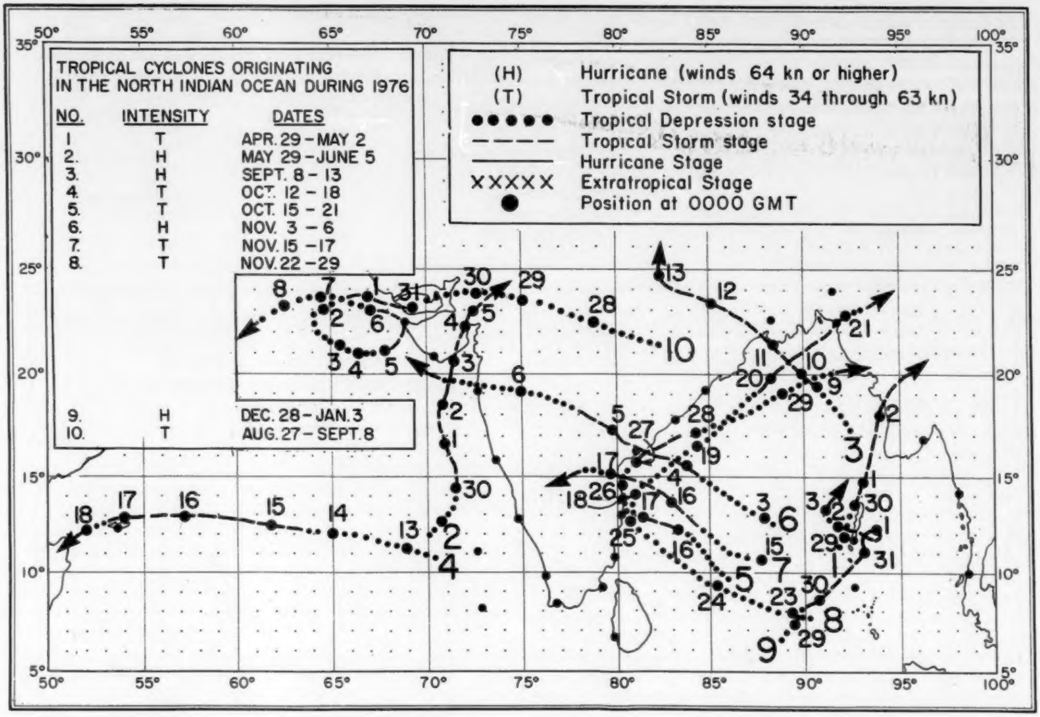


Figure 30.--North Indian Ocean tropical cyclones, 1976.

within 30 mi of Port Blair that day. The observatory at Port Blair recorded a 52-kn gust and a pressure of 993 mb. The Naval Meteorological Office recorded a 60-kn gust with a 994-mb pressure. The Navy ship INS SAKTI, anchored at Port Blair, recorded a 75-kn wind with a pressure of 989 mb. In association with this system rainfall was widespread in the Bay islands from December 27 through January 2. Port Blair and Long Island recorded 14.6 in and 12.6 in, respectively, on the 31st, establishing new records.

On the Editor's Desk

HURRICANE STORM SURGE PROGRAM PROTECTS COASTS

Atlantic and Gulf Coast areas where hurricane storm surges could be expected to create dangerous flooding will get early warning of such threats from computer models being developed by NOAA. Two different models already have been used operationally last season.

Twenty models, called SLOSH for Sea, Lake, and Overland Surges from Hurricanes, will be developed over the next several years for coastal areas from Massachusetts to Texas where complex terrain features make it difficult to forecast the effects of the mounds of wind-driven water known as storm surges. These deadly surges can reach heights of 20 ft or more during severe hurricanes, inundating vast reaches of coastland.

Models already have been developed by NOAA's National Weather Service for the New Orleans area, Lake Okeechobee, Fla., and Tampa Bay, Fla. Other models either are now being prepared or are scheduled for development for Mobile Bay, Ala.; Galveston, Tex.; Charlotte Harbor, Fla.; Florida Bay-Biscayne Bay-Florida Keys; Long Island Sound, N.Y.; Chesapeake Bay; Charleston Harbor, S.C.; Narragansett Bay, R.I.; Buzzards Bay, Mass.; Delaware Bay; Pamlico Sound, N.C.; Massachusetts Bay; Corpus Christi, Tex.; Lower Laguna Madre, Tex.; Matagordo Bay, Tex.; Lake Sabine, Tex.; and Pensacola, Fla.

The New Orleans model was used during hurricane Bob in early July, which struck with minimal force near the city. Forecasters in New Orleans said the model performed exceptionally well, and information from it was helpful in preparing local warnings for southeast Louisiana.

A second research model developed by NOAA's En-

vironmental Research Center in Boulder, Colo., and using a somewhat different approach from the SLOSH models, was made available when it appeared that hurricane Frederic would strike Mobile, Ala., in September. This model, too, worked with perfection, giving 12 hr advance warning of the lethal storm tide which surged into Mobile Bay.

The SLOSH computer program contains topographical information on lake and river basin configurations and water levels, levee systems, roads, and other geographical features. The model can compute the surge resulting from various combinations of wind and pressure brought by the storm.

The program is put into action when a hurricane approaches. Information on the storm's winds and the speed and direction of its forward motion--gathered from ships, satellites, aircraft, and radar observations--are fed into computer terminals at the National Hurricane Center in Miami and at Weather Service Forecast Offices.

The computer produces storm surge height predictions based on the predictions of storm intensity and movement. Tide levels, storm surges, and wave actions combine to produce the destructively higher water levels associated with hurricanes.

ST. LAWRENCE SEAWAY CLOSING

The St. Lawrence Seaway officially closed at midnight December 18, but several vessels transited the locks late. The late ships had to pay an $80,000 operational surcharge. Although the weather remained mild, the closing date was not extended because of a planned extensive winter maintenance program of $1.8 million on the Eisenhower and Snell Locks.

Vessels were considered late if they had not reached the Cape Vincent call-in point by the deadline. The deadline had already been extended 3 days because of a backlog of export grain. At last count there were eight vessels that had to pay the surcharge, seven downbound and one upbound. The FEDERAL ST. CLAIR was the only ocean vessel and was downbound with a cargo of grain. There were six late Canadian lakers with grain cargoes downbound. The Canadian laker MAPLE CLIFFE HALL was late upbound because of repairs in Montreal.

The Greek oceangoing freighter ARCHANGELOS will spend the winter in the Lakes. She ran aground at Crossover Island after loss of steering. She was successfully refloated on the 21st, but her draft was too deep to transit the Seaway.

Dewatering of the two U.S. locks began as scheduled.

BEST BUOY COLOR TEST

The U.S. Coast Guard plans a nationwide, year-long test to evaluate whether green buoys can be seen better and their color recognized by mariners at greater distances than traditional black buoys.

Test sites throughout the United States have been selected to cover as many types of water conditions, visual backgrounds, and classes of users as possible.

The Coast Guard said that green markings now in use on beacons in the United States have received wide acceptance from mariners. In addition, green buoys have been used for some time outside of North America for various purposes and have proven effective. According to the Coast Guard, the special evaluation will attempt to verify if, for U.S. applications, green is more effective than black as a day signal color for buoys.

Green test buoys will begin to appear at various locations between March 1, 1980, and May 31, 1980. These buoys and their locations are:

Providence River Approach Channel in Rhode Island, Lighted Buoy 7

Providence River Channel in Rhode Island, Buoy 21

Upper Mississippi River in the vicinity of St. Louis, Mo., two specially deployed test aids

Sandy Hook Channel in New Jersey, Lighted Gong Buoy 5

Deepwater Point Range in Delaware, Lighted Bell Buoy 5D

Craney Island Channel in Virginia, Lighted Buoy 19

Bloody Point Range in Georgia, Lighted Bell Buoy 7

Miami Main Channel in Florida, Lighted Buoy 3

Pascagoula Channel in Mississippi, Lighted Buoy 21

Kelso Marine Terminal Channel in Texas, Buoy 55

East Outer Channel in Michigan, Buoy 5

Green Bay Harbor Entrance Channel in Wisconsin, Lighted Buoy 31

San Diego Bay Channel in California, Lighted Buoy 9

Astoria Crossing in Oregon, Lighted Buoy 37

Swinomish Channel in Washington North Entrance Buoy 17

Hilo Harbor in Hawaii, Lighted Buoy 3

Wrangell Narrows Channel in Alaska, Buoy 13A

Womens Bay Entrance Channel in Alaska, Lighted Bell Buoy 3

Mariners are encouraged to compare the two colors and send comments in writing to the Coast Guard Aids to Navigation Branch at the Coast Guard District Office nearest them.

ANCIENT SEAWEED COLLECTED FROM DEEP SEA BOTTOM

University of Rhode Island marine geologists have retrieved 10,000-yr-old seaweed buried intact deep in smelly black mud from the Gulf of Mexico. The discovery was made during a study of microfossils contained in highly unusual sediments from the Orca Basin in the northwestern Gulf of Mexico.

The seaweed, a type of sargasso which was weighted down by attached worm tubes, evidently broke off from a larger clump and sank rapidly 7,800 ft to the basin floor. Under normal deep-sea conditions, the seaweed would have been eaten by bottom bacteria. However, it happened to fall into a large, anoxic (unoxygenated) area and was preserved under a constant rain of sediment, plant, and animal debris from the overlying waters.

Over 10,000 yr later, the seaweed was recovered in a sediment core taken from the ocean bottom in a 250 mi^2 area called the Orca Basin. There is interest in this basin because its organically rich sediments are the same type that sometimes form oil and gas when buried for millions of years under intense heat and pressure conditions.

In the Orca Basin dense, salty water is trapped beneath lighter water, and no circulation occurs to oxygenate the waters near the bottom. The result is an anoxic area in which there are no bacteria to break up organic debris nor any burrowing organisms which mix the upper layers of sediment. The debris which falls is preserved just as it is deposited. This provides an excellent record of what plants and animals were present at what eras in the past. Because scientists know what organisms lived during colder periods versus warmer ones, the Orca Basin thus provides excellent clues as to what the North American climate was like in past centuries.

GLOBAL WEATHER EXPERIMENT ENDS

The largest weather experiment in history--involving 147 nations and a massive array of scientists, satellites, ships, aircraft and buoys--ended November 30, 1979.

The year-long Global Weather Experiment provided the most complete worldwide weather record ever assembled. With it, scientists will try to learn the practical limits of weather forecasting and to design a global system to achieve them.

In particular, we would like to thank the many cooperating ships that have participated in this program. Continue to keep up the good work.

Information from the experiment also produced immediately useable benefits. Drifting buoys, satellites, and constant-level balloons made a winning combination. The three systems gave immediate data from huge areas of ocean that cradle storms and that have no permanent weather stations--only occasional ship reports. All this data was collected and processed in France and immediately relayed to the Global Telecommunication System of the World Weather Watch for use by weather forecasters the world over.

Five geostationary satellites (three U.S. spacecraft operated by NOAA, one Japanese, and one from the European Space Agency) girdled the globe and for the first time provided an instantaneous and simultaneous view of the development of tropical storms around the globe. Meteorologists could see all the storms around the globe at once, watch new ones spawning, and trace their paths as long as they lasted.

They also had a better view of the effects of the weather systems on each other, which will translate into improved models and lead to better, more accurate forecasting.

Two NOAA polar-orbiting satellites--TIROS-N and NOAA-6--gave temperature data far superior to previous polar orbiters and covered vast ocean areas where no other data was available. Again, this information helped produce better forecasts.

A network of 368 instrumented drifting buoys--113 from the United States, 95 ship-launched, and the remainder air-dropped--were deployed. Of these, 307 covered great areas of ocean south of the Equator, transmitting weather data automatically, and resulting in greatly improved weather forecasting in Australia and elsewhere in the Southern Hemisphere.

The success of the Southern Hemisphere drifting buoy program has already stimulated international efforts to devise an operational system for the Northern Hemisphere. The United States plans to initiate a drifting buoy program in the northeast Pacific to provide more information on the major storms that develop there and that eventually move across the United States.

Balloons designed to float at a constant altitude, about 46,000 ft, monitored high-level winds over the Equator. As many as 104 were in the air at the same time; 313 were used altogether. Data taken by the balloons were picked up by the polar-orbiting satellites and fed immediately into the global weather grid.

An aircraft dropwindsonde system, developed for the experiment, had an unexpected and timely payoff during hurricane Frederic. A typical hurricane dropwindsonde mission was flown by a NASA aircraft on September 7, when the storm's center was located on the northeast coast of Cuba and deepening. The mission was flown along the periphery of Frederic, to the northeast, north, and northwest of the center, to help determine the steering windfield.

The resulting measurements helped meteorologists at NOAA's National Hurricane Center forecast the probable path and speed of the hurricane.

In addition to the immediate benefits, the Global Weather Experiment successfully achieved the observational goals established for it more than a year ago by the World Metoorological Organization (WMO) and the International Council of Scientific Unions. Scientists and technicians from 70 nations and five international organizations were directly involved in the massive project, and all 147 members of the WMO contributed in some way.

U.S. participation in the experiment was coordinated by NOAA and included the Departments of Commerce, Defense, Energy, Interior, Transportation, and State; NASA, the National Center for Atmospheric Research, Defense Nuclear Agency, Air Force, Army, Navy, and Coast Guard; and many academic institutions.

The U.S. aircraft dropwinsonde system developed for the experiment has improved to a point where it will be a part of the new Improved Weather Reconnaissance System (IWRD) to obtain improved observations of tropical and major winter storms.

The year-long test of the prototype Aircraft-to-Satellite Data Relay (ASDAR) system was highly successful, and the results should lead to an operational

system. A fleet of 17 wide-bodied jets was equipped with instrument packages developed by NASA which automatically radioed wind, temperature, and pressure readings to the geostationary satellites for incorporation in the worldwide weather telecommunications network. Nine airlines cooperated in the program, and more than 800 high-quality observations were received on an average day. ASDAR proved particularly useful in obtaining weather data from remote regions of the world.

The Polar Experiment (POLEX), part of the overall Global Weather Experiment, made possible the accurate description of important surface meteorological patterns that otherwise would have gone undetected, such as major high-pressure areas in the Arctic basin. Supported by the National Science Foundation, POLEX field scientists placed 21 ice buoys in the Arctic basin and 15 in the western Weddell Sea off Antarctica.

Scientists are immensely pleased with the operational phase of the Global Weather Experiment, but the real advantages will materialize when they have analyzed all this mass of data and everything that has been learned is incorporated into global ocean and weather prediction models. There will be two important advances--better weather forecasting and a start of global climate simulation.

NOAA RESEARCH SHIP CHAPMAN LAUNCHED

A 127-ft fisheries research vessel was launched on December 8, 1979, at the Bender Shipbuilding and Repair Company, Inc., Mobile, Ala. The multipurpose ship, named the CHAPMAN (fig. 31), will be used for stock assessment in the North Pacific 200-mi fisheries zone.

The CHAPMAN, the first new vessel built for NOAA since it was established 9 yr ago, will be a modified stock design combination crabber/trawler, with accommodations for 17 crew and scientists.

The $3 million research vessel, with a beam of approximately 30 ft and a 13-ft draft, will have a range of 6,000 mi at 11 kn. The power plant will deliver 1,250 shaft hp at 1,225 rpm.

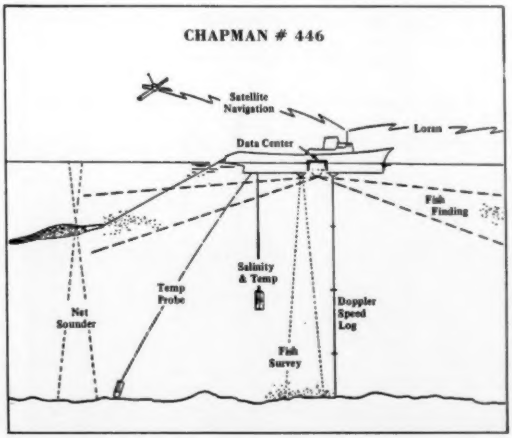


Figure 31. -- Diagram showing the capabilities of the CHAPMAN.

Named after Dr. Wilbert McLeod Chapman, a prominent West Coast fisheries scientist, the ship will provide stock assessments as a basis for fishery management actions by using conventional types of commercial gear, including bottom trawls, midwater trawls, bottom and surface longlines, gill nets, and pot fishings. It will have two research laboratories, and an 8- by 20-ft portable scientific van.

Two trawl winches, typical of this size commercial fishing vessel, will have a pull of about 20,000 lb net and each will be equipped with 1,000 fathoms of 3/4-in trawl wire.

The CHAPMAN will be commissioned in Seattle, Wash., early this year at NOAA's Pacific Marine Center.

GREAT LAKES ON ROAD TO RECOVERY

Efforts to improve the quality of Great Lakes waters may show results sooner than expected, and Lake Ontario, at least, is already healthier than it was a few years ago, according to NOAA scientists.

Results from a computer model indicate that the largest lakes could show decreasing loads of pollutant phosphorous in several decades--a tenth of the time predicted in earlier calculations--and Lake Erie could show such improvement in less than a year. The calculations were made by NOAA's Great Lakes Environmental Research Laboratory in Ann Arbor, Mich., using a model that simulates the effects of pollutant phosphorous in the Lakes and predicts the results of pollution-abatement efforts.

Phosphorus from detergents, sewage, and runoff from land has been a major pollutant of the Great Lakes. The nutrient, in excess, speeds up the aging process of a lake. Nutrient-stimulated overproduction of algae leads to depletion of oxygen in the waters. The process, known as eutrophication, brings on such rapid growth that the lake, in effect, chokes itself to death.

In the early 1970's, in an attempt to halt the visible deterioration of the Lakes, both the United States and Canada passed legislation limiting the amount of phosphate in detergents. Detergent phosphates had accounted for about half of the nutrient in domestic wastewater poured into the Lakes.

Lakes are not passive receptacles for pollution; however, they have their own self-cleansing processes. Fresh waters flow in from rainfall and rivers, and escape through the lake's outlet in a process called flushing. Before the phosphorus controls were put into effect, scientists made estimates of how long it would take for reduced pollutant inputs to result in improved water quality. For the larger lakes, Michigan and Superior, the estimates were that it could take centuries. But these estimates neglected another important cleansing process, one that is especially effective for nutrients such as phosphorus. The nutrients become associated with particulate matter in the water and sink to the bottom to become part of the sediments. Thus, sedimentation represents a cleansing mechanism that supplements flushing and would, therefore, enhance the lake's ability to recover.

It was calculated that the amount of phosphorus added to Lake Ontario, for example, dropped from a high of about 16,500 tons a year in 1972 to present levels of about 11,000 tons a year. Taking both cleansing processes into account, these figures were used to calcu-

late the resulting improvement in water quality in the Lakes. The results showed that phosphorus in lake waters would have peaked in spring 1973, but by 1978 it had dropped by about 25 percent. Actual measurements of phosphorus in water samples collected by Canada's Centre for Inland Waters agree with these calculations.

It was also calculated how long it would take, with both sedimentation and flushing at work, for each lake to recover from a dose of phosphorus. The longest time was 32 yr for Lake Superior. Lakes Erie and Ontario, though they suffer some of the most intense inputs of phosphorus in the smallest water volumes, also have the most rapid flows. Erie would adjust to a change in the amount of phosphorus in less than a year; Ontario and Huron would take nearly 8 yr; and Michigan would take 13 yr.

BUOY REPLACES COLUMBIA LIGHTSHIP

A Large Navigation Buoy (LNB) (figs. 32 and 33) replaced the Columbia Lightship at the mouth of the Columbia River on November 1, 1979. The Columbia River Lightship was the first manned lightship on the West Coast, established in 1892. She was also the last manned lightship on the West Coast, the third of that name. One lightship is still in service off Massachusetts.

The LNB is 40 ft wide and 42 ft high; it is located at the same position as the lightship. It has a light range of 14 mi, a radiobeacon, a radar beacon, and a fog signal. Weather and wave information are transmitted to the local Coast Guard unit for dissemination. The buoy weighs about 104 tons fully loaded. It is powered by a diesel/electric generator plant. All systems have identical backup systems in case of failure. The buoy is designed to remain on station and function in winds up to 100 kn and waves to 50 ft.

Figure 33.--A closeup of the Large Navigation Buoy on station at the mouth of the Columbia River. Official U.S. Coast Guard Photo by Mike Kelley.

NWS TORNADO HIGHLIGHTS OF THE 1970'S

Every State in the United States experienced at least one tornado during this decade. While the total number

Figure 32.--A photograph of the LNB and the COLUMBIA as she stood by during the check out of the buoy. Official U.S. Coast Guard Photo by Mike Kelley.

of tornadoes reported, 8,560, represents a 25-percent increase over the 1960's, the death toll of 986 is up only 6 percent based on preliminary reports.

By far the worst tornado disaster of the decade occurred on April 3 and 4, 1974. Dubbed the superoutbreak, it spawned some 146 tornadoes resulting in 307 deaths and more than 5,000 injuries. Fatalities by State included Alabama - 77, Kentucky - 71, Indiana - 47, Tennessee - 44, Ohio - 40, Georgia - 16, North Carolina - 6, Illinois - 2, Michigan - 2, Virginia - 1, and West Virginia - 1. There were also 6 deaths in Canada.

Other tornadoes with significant loss of life during the 1970's included:

Date	Deaths	Location
4-18-70	16	Clarendon, Tex.
5-11-70	26	Lubbock, Tex.
2-21-71	123	Louisiana (11); Mississippi (110); North Carolina (2)
3-31-73	7	Abbeville, S.C.
5-27-73	7	Demopolis/Brent/ Mt. Cheaha, Ala.
6-8-74	21	Drumwright, Okla. (13); Emporia, Kans. (6); Tulsa, Okla. (2)
1-10-75	9	McComb, Miss.
3-28-75	7	Warren, Ark.
4-4-77	22	Birmingham, Ala.
6-17-78	16	Lake Pomona, Kans.
4-10-79	56	Wichita Falls, Tex. (42); Vernon, Tex. (11); Lawton, Okla. (3)

Unusual tornadoes of the 1970's included:

April 5, 1972	Vancouver, Wash.--6 killed, 300 injured. Only West Coast tornado known to have produced fatalities during the 20th century.
October 3, 1979	Windsor Locks, Conn.--3 killed and 500 injured. Damage estimated near $200 million.

States in the ten top list for the 1970's include:

Number of Tornadoes		Number of Deaths	
1. Texas	1425	1. Mississippi	145
2. Florida	658	2. Texas	137
3. Oklahoma	426	3. Alabama	121
4. Nebraska	381	4. Kentucky	83
5. Illinois	364	5. Tennessee	56
6. Iowa	304	6. Oklahoma	55
7. Kansas	303	7. Indiana	54
8. Mississippi	292	8. Ohio	47
9. Louisiana	278	9. Georgia	33
10. Arkansas	263	10. Kansas	31

Tornadoes and deaths of the decade by years nationwide:

	Tornadoes	Deaths
1970	653	72
1971	888	156
1972	741	27
1973	1102	87
1974	947	361
1975	920	60
1976	835	44
1977	852	43
1978	788	53
1979	826	83 (Prelim.)

But what of the decade that lies ahead. Of course, there is no way to forecast the tornado effects of the 1980's, but we can look back at history for insights. It seems reasonable to expect that hundreds of people will be killed by tornadoes during the 1980's--perhaps as many as 1,000. Many of these deaths will be needless--apathy contributing to the ignoring of watches and warnings that could be lifesavers. As the population continues to grow and metropolitan areas spread out, we will find that tornadoes will have larger targets to strike. Storms which in the past may have hit open country will now hit urban areas. This will put a strain on the forecast system, and the challenge in the 1980's will be to improve tornado preparedness as well as detection and warning systems to minimize the loss of life.

WAVES POWER FRESH WATER FROM OCEAN

Energy from waves is being used to power a system which removes the salt from sea water, making it fit for human consumption, under a University of Delaware Sea Grant Program.

Scale models of the system have been tested in the laboratory and at sea, and future research under the Sea Grant will undertake the construction and testing of a model to generate 1,500 gal of freshwater per day from the sea.

A unit of that size could provide enough fresh water for coastal communities of about 500 persons. Additionally, the device's design permits it to be built economically and to be operated for long periods of time without significant maintenance.

The desalination system uses a molecular filtration technique known as reverse osmosis. Waves power a high-pressure pump that filters out substances like sodium and chlorine, but permits water molecules to pass through.

MARINE WEATHER REVIEW

The Smooth Log (complete with cyclone tracks, climatological data from U.S. Ocean Buoys, and gale and wave tables) is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The Rough Log is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both Smooth and Rough Logs, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

July and August 1979

SMOOTH LOG, JULY 1979--The storm tracks this month closely followed the climatological pattern with some shifts in geography. Two primary paths, one from over the Great Lakes and one from the U.S. East Coast, met between St. John's and Kap Farvel to continue over Iceland. There were several cyclones over Scandinavia and over or near the Iberian Peninsula. A climatological track over Hudson Bay turned sharply northward over Baffin Island. The difference from the climatic tracks was the location of one track farther south than usual over the Great Lakes. Another difference was the joining of the two tracks south of Kap Farvel.

The Azores High dominated the North Atlantic from latitude 10° to 50°N in the mean (fig. 34). It ridged sharply into France and the eastern United States. Its mean center was 1029 mb near 37°N, 33°W, which was 4 mb higher and about 300 mi northeast of its climatic position. There were three weak LOWs across the subpolar region as climatology indicates. A 1005-mb center over Baffin Island was about 400 mi north of its normal position. A 1009-mb LOW was normally positioned over Iceland as was a 1008-mb center over the Gulf of Bothnia.

Positive anomalies stretched from 10° to 60°N latitude and the Mississippi River eastward to the U.S.S.R. The largest were 6 mb off Brest and 4 mb near the center of the High. Significant negative centers were minus 5 mb over Baffin Island and minus 3 mb over the Baltic Sea.

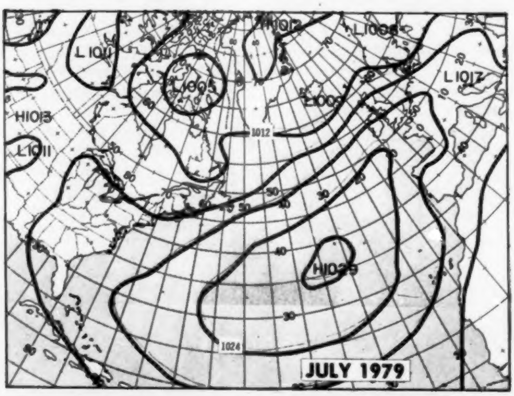


Figure 34.--Mean sea-level pressure, July 1979.

In the upper air at 700 mb the primary differences from climatology were closed LOWs corresponding to the surface LOWs in the subpolar region. Each surface LOW had a corresponding closed circulation at 700 mb. These are normally only reflected as troughs at 700 mb. The flow across the major shipping lanes was primarily zonal.

Hurricane Bob and tropical storm Claudette were named this month. This is one more than the long-term average. There was also a tropical depression. Both storms brought heavy rains inland, especially Claudette, which was a minimal storm.

<u>Extratropical Cyclones</u>--The Bermuda-Azores High was the dominant feature this month, with transitory LOWs moving over and along its western and northern edge. Several times during the month the High retreated southward and/or split into multiple centers, thus allowing LOWs to develop and to penetrate farther south, particularly over or east of the Iberian Peninsula.

The first storm of the month came out of the Great Lakes. At 1200 on the 3d it was 990 mb over the Gulf of St. Lawrence. The weather station at Mt. Washington reported 40-kn winds. On the 4th OWS Charlie measured 37-kn winds and 15-ft waves. On the 5th the swell increased to 16 ft. The THOMAS CARLETON on the Bay of Fundy had 56-kn northwesterly winds as a trough passed and probably partially due to funneling. Wind gusts to 60 kn were recorded at Frying Pan Light Tower in North Carolina. On the 6th the LOW broke up over Kap Farvel. High pressure following the LOW again brought record summertime low temperatures to the northeastern part of the United States. Washington, D.C., set a new record this summer when the temperature did not reach 90°F until July 12.

This storm formed as a frontal wave off Delaware Bay on the 5th. The front stretched out of the previous LOW. The TFL LIBERTY near 39°N, 63°W, found 20-ft swell waves with 40-kn winds. By 0000 on the 6th the central pressure had plunged to 982 mb over Cabot Strait. Mount Washington Observatory in New Hampshire recorded winds of 79 kn. The CETRA CARINA was 500 mi south of the center when she encountered 50-kn northwesterly winds. Five Canadian ships in the vicinity reported 35- to 42-kn winds near

45°N, 60°W; none reported waves. An American ship (WWBB) had reported 38-kn winds from the northeast north of the center at 2100 on the 5th. At 0300 on the 6th the LUCY MAUD MONTGOMERY (47°N, 62°W) had 50-kn winds with a pressure of 986 mb. The SAM HOUSTON found 20-ft seas at 1200 about 400 mi south of the 982-mb center.

On the 7th gales were still being reported, and OWS Charlie had 37 kn late in the day with waves as high as 20 ft. On the 8th Lima measured 35 kn, and the C. P. VOYAGEUR had squalls with 15-ft swells. The ARNI FRIDRIKSSON was off the east coast of Iceland at 1800 with 49-kn easterlies. The LOW stalled several times as it approached Iceland and weakened and finally dissipated over Scoresby Sound.

This LOW can be traced back to its origin near Mackenzie Bay on the Beaufort Sea on the 5th. It traveled southeastward across northern Canada as a weak LOW or frontal wave before crossing into the Labrador Sea on the 9th. Although the LOW was very weak (999 mb) on the 10th, there was a tight gradient between it and the Azores High (1034 mb). The DAWSON was east of St. John's with 37-kn winds. Later Charlie had 35-kn gales and 18-ft waves. At 0000 on the 12th the LOW was 995 mb south of Iceland. The POLYARNYY KRUG was near 56°N, 32°W, with strong 45-kn gales. At 0600 the MANCHESTER CRUSADE had 38-kn winds near the same position, and at 1200 Lima measured 40-kn winds from the southwest. On the 13th the seas were 15 ft. The storm moved over Iceland on the 13th and dissipated over the Greenland Sea.

With the demise of tropical depression No. 4 well east of Cape Hatteras, a wide low-pressure trough remained. Two small extratropical centers were apparent at 1200 on the 12th. The SUSAK was near the northern center with 37-kn southerly winds. At 1800 the NOVO MESTO (37°N, 61°W) was east of a sharp trough line with 48-kn winds from the south; at 0000 on the 13th they had shifted to westerly. The ASIAN RENOWN at 54°N, 46°W, was very near the 993-mb center at 1800 on the 14th with 50-kn winds. On the 15th OWS Charlie measured 35-kn winds and 16-ft seas.

The storm sailed south of Iceland on the 16th, and there were gale reports from fishing vessels in the area. The storm drifted across the Norwegian Sea and dissipated over the Gulf of Bothnia on the 22d.

This very short-lived storm only affected a few ships. It developed as a frontal wave over Labrador by 0000 on the 23d. At 1200 it was over the Labrador Sea, and the LABRADOR off Hopedale had northerly 41-kn winds. At 1800 the KUNUNGUAK was in Davis Strait with 46-kn southerly winds. By 1200 on the 24th the LOW had disappeared south of Kap Farvel.

Among others an observation from the SEA-LAND GALLOWAY was instrumental in first analyzing this frontal wave on the 21st. Her wind direction and barometric pressure were especially important. The LOW was very shallow for the first 3 days, supported by only a trough at 10,000 ft. It wandered around the area near 48°N, 40°W, until the 24th when a closed LOW appeared at 700 mb. On the 25th the CAPE ROGER (47°N, 46°W) found 35-kn gales and 13-ft seas. At the time the LOW was 998 mb near 50°N, 33°W. At 2100 the ESCHERSHEIM was in the southwest quadrant with 37 kn and 16-ft seas.

On the 27th at 0600 OWS Charlie was northwest of

Figure 35.--These tightly moored shrimp boats at Biloxi, Miss., were not damaged, but the high seas flooded the cars on the dock. Wide World Photo.

the center and measured 41-kn winds. The storm moved almost directly over OWS Lima at 0000 on the 28th and plunged southward to disappear.

Tropical Cyclones--Hurricane Bob developed from one of many disturbances that originate over Africa each hurricane season. It was first detected in the eastern North Atlantic near the Cape Verde Islands in the last week of June. The system continued westward without showing any signs of development until it reached the northwestern Caribbean on July 6. It crossed the Yucatan Peninsula, and a weak circulation began forming on the 8th and organized into the third tropical depression of the year the following day.

On the morning of the 10th Air Force reconnaissance aircraft reported a developing tropical storm about 400 mi south of the Louisiana coast with maximum winds of about 50 kn and a pressure of 998 mb, a drop of 14 mb since the flight the previous day. Afternoon flights measured winds of 60 to 70 kn and a pressure of 988 mb. The storm was upgraded to a hurricane late that afternoon, and it remained a minimal hurricane with lowest pressure of 986 mb as the center moved inland west of Grand Isle, La., early on the 11th (fig. 35). There were reports from at least six American ships in the vicinity of gale-force winds with the highest waves being 11.5 ft.

After moving inland Bob moved north-northeastward up the Mississippi Valley into western Tennessee on the 12th and into southern Ohio on the 13th. Thereafter, the low-pressure area that was once Bob drifted southeastward off the mid-Atlantic coast on the 16th and was absorbed into a low-pressure system over the western Atlantic.

Statistics associated with Bob are typical of a minimal hurricane. Tides were generally 3 to 5 ft above normal, and rainfall totals were between 3 to 6 in. The highest winds were 45 to 55 kn along the coast, with a few locations reporting 65 kn. Eight tornadoes were reported, but only one produced significant damage estimated at $27,500 in Biloxi, Miss. There was one death and one injury in Lafitte, La., when two men were blown off a marina roof during the height of the storm. No serious flooding was reported in Louisiana, Mississippi, or Alabama, but the remnants of Bob produced flooding over portions of Indiana, Ohio, and West Virginia. A number of boats were sunk or damaged, and there was considerable pier damage from high tides and rough seas. Besides the usual downed trees and powerlines, gusty winds broke windows in the business district of New Orleans. Total storm damage may reach several million dollars, which includes about $250,000 in Harrison County, Miss.

Tropical storm Claudette developed twice from a tropical wave. The first time, on the 16th, she was some 400 mi east of Guadeloupe. Moving west-northwestward, she intensified to tropical-storm strength on the 17th as she approached the Leeward Islands. Maximum winds reached 40 kn in squalls as Claudette moved through the Virgin Islands and about 25 mi to

Figure 36.--People leaving the flooded areas of Houston, Tex., caused by heavy thunderstorms associated with Claudette. Wide World Photo.

the north of San Juan. Its passage close to Puerto Rico and across the Dominican Republic caused Claudette to weaken to a depression and then to a tropical wave.

It was this wave that entered the Florida Straits on the 20th. By the afternoon of the following day, a depression had formed west of Key West. A ridge at upper levels stretched from the Atlantic across the southeastern United States into Texas. This ridge kept the depression on a slow west-northwest course across the Gulf to a point 225 mi south-southwest of Lake Charles, La. At this point on the morning of the 23d, the depression became minimal tropical storm Claudette.

On the 23d and 24th a short-wave impulse dipped out of the westerlies long enough to break down the ridge over Texas. This allowed Claudette to move northward making landfall around 2 p.m. CDT on the 24th in southwestern Louisiana about 17 mi west of Cameron. The storm was downgraded to a depression that same evening. Once Claudette was inland, the short wave retreated to the north cutting off the low-pressure remains of Claudette from the westerlies. This left the low pressure stalled over southeastern Texas through the morning of the 26th. On the 26th and 27th the LOW drifted northward through eastern Texas, Oklahoma, and Arkansas. On the 28th the LOW began moving more rapidly to the northeast through the Ohio Valley, gradually filling.

Through much of its lifetime tropical storm Claudette was erratic and disorganized. After reaching tropical-storm strength south of Lake Charles on the 23d, it became disorganized the night of the 23d and was downgraded to a depression, only to have a new center form the morning of the 24th and once again become a tropical storm. It appears that Claudette reached her maximum intensity shortly before landfall. After moving inland the low pressure strengthened some the night of the 25th and 26th. This undoubtedly contributed to the heavy rain in Texas (fig. 36).

Claudette's highest recorded wind was a gust of 52 kn and highest sustained wind 34 kn, both in Port Arthur, Tex. Unconfirmed gusts to 59 kn were reported at Grand Isle, La., as a band of high winds swept the Louisiana coast prior to Claudette's landfall. A CHURN station at Cameron, La., reported winds of 45 to 55 kn, but these are regarded as unreliable. Port Arthur also had the lowest recorded pressure of 998 mb. An unconfirmed pressure of 992 mb was reported at Bridge City, Tex. The lowest estimated pressure before or during landfall was 986 mb. The highest tide was 4 ft MSL at Lake Charles, La., with an estimated 4.5 ft MSL at Sabine Pass, Tex. Rainfall was extremely heavy with serious flooding in southeastern Texas. Southwestern Louisiana also had heavy rain with over 9 in in 57 hr in the Lake Charles area, but no flooding problems resulted there.

One death occurred while Claudette was moving inland. In Louisiana the impact of Claudette was mainly confined to the immediate coast. Eight miles of LA 82 were badly damaged or destroyed by roadbed washout from tidal action, and about 14 mi of secondary roads were damaged in Cameron parish. Seven homes or fishing camps were destroyed or heavily damaged by winds and waves in Johnsons Bayou near the point of landfall. A mile-long section of beach was eroded back 40 ft in Constance Beach. A number of mobile homes were overturned in Oak Grove. Several boats were sunk at their moorings along the beach. There was minor coastal flooding in communities on coastal bays and bayous as far east as Jefferson parish due to the prolonged southerly flow into Claudette. One station in Sabine Pass, Tex., suffered major roof damage. Otherwise, most of the damage other than flooding in Texas and Louisiana was primarily minor roof damage and downed trees and powerlines. Damage was estimated at over $100 million.

On July 19 the OTTO N. MILLER was sailing northward off the coast of Senegal and sent the following special observation: "Passing through a forming tropical depression with wind starting from north, then changing to northeast and at 2000 changed to east. Encountered extraordinary heavy rain and intense lightning. Barometer fell to 1013.0 mb and very unsteady. Maximum wind gusts 40 kn. At 2100 barometer 1016.5 mb and moderate rain. Direction of depression was about southwest, speed estimated to be around 30 kn."

A check of the 0000 chart of the 20th showed continuous rain and lightning at the coastal weather stations.

Casualties--The 1,585-ton STAR EXPRESS sustained heavy-weather damage July 1 and 2 near 14.5°N, 71.6°W. The British GEFION sank about 20 mi off St. Lucia, al-

Figure 37.--The ATLANTIC EMPRESS waits to be towed farther to sea to reduce the danger of pollution and other safety factors. Wide World Photo.

legedly during heavy weather on the 13th. The 7,952-ton DOVER castle reported at Marseilles on the 13th with weather damage. The new drilling platform GLOMAR JACKUP 1 lost its heliport in heavy weather while being towed from Quebec to Galveston.

Two fully laden very large crude carriers, the Liberian AEGEAN CAPTAIN (210,000 tons) and Greek ATLANTIC EMPRESS (292,000 tons), collided in rain and fog 18 mi off Tobago the night of the 19th (fig. 37). Twenty-six crewmen from the ATLANTIC EMPRESS and one from the AEGEAN CAPTAIN were missing. Both vessels caught fire. Fire aboard the AEGEAN CAPTAIN was extinguished, but the fire on the ATLANTIC EMPRESS was never controlled--she finally sank on August 2.

The American yacht HAUPT SACHE went aground near Porto Ercole, Italy, during gales. The 110-ton Moroccan ASSFA sank in fog 4 mi off Agader on the 22d. Only 2 crewmen of 11 survived. The British deck barge EL TORITO was beached near Hunting Cay following heavy weather. The 18,736-ton Liberian ore carrier VIDA's engine stopped in fog near the Orkney Islands. Twenty-six crewmen abandoned ship and were rescued by the B.P. SPRINGER. The vessel was taken in tow. The 2,646-ton crane/diving mother vessel PACIFIC INSTALLER lost two anchor buoys and one anchor in heavy weather.

Other Casualties--The 3,000-ton Brazilian MANSUR SIMAO sank in heavy weather 70 mi north of the Rio Grande Bar on the 3d. The 7,282-ton SAFOCEAN AUCKLAND slipped starboard anchor plus 10 shackles of cable plus damage to windlass and motor during heavy weather at Port Elizabeth Roads on the 21st. The 8,576-ton Greek AIFANOURIS shipped water in cracked hatch during heavy weather. The Singapore 6,336-ton TONG NAM broke in half in heavy seas 30 mi northeast of Durban during 30-ft waves and gale-force winds. Six of 38 crewmen were rescued. The master apparently attempted to turn the vessel in extremely heavy weather to return to Durban.

SMOOTH LOG, AUGUST 1979--The chart showing the tracks of low-pressure centers was very busy this month for a summer month. This was especially true over northeastern Canada and over waters between Newfoundland and Iceland. Storms fed into a focal point south of Kap Farvel from the west and southwest. The area bordering the North Sea had a stormy month.

The mean sea-level pressure analysis was near normal (fig. 38). The area south of the zero isoline, which stretched from Cape Chidley to Ireland, was slightly positive. The highest positive area was off the Iberian peninsula with a maximum of 4 mb. The area of highest negative anomaly was minus 5 mb over Foxe Basin.

The Azores High was 1025 mb near 37°N, 30°W, north of the Azores Islands. There were two LOW centers, a normally located one south of Iceland at 1008 mb and a 1004-mb center over Foxe Basin about 500 mi northwest of its usual 1008-mb position over Cape Chidley.

The flow in the upper air was mainly zonal over the ocean between latitudes 40° and 60°N. The long-wave troughs were over the interior of eastern North America and western Europe. There was a short-wave trough that paralleled the North American coast from

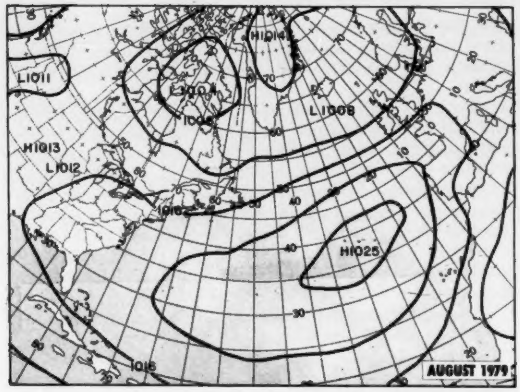
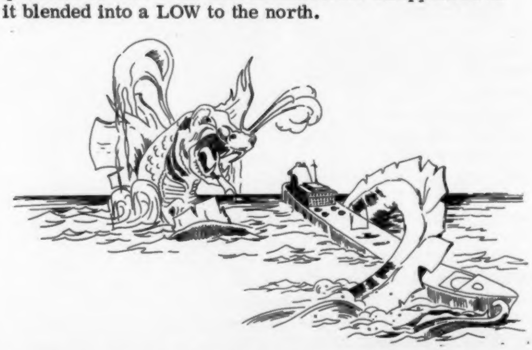


Figure 38.--Mean sea-level pressure, North Atlantic, August 1979.

Newfoundland to Cape Hatteras. The major difference from climatology was a closed LOW, rather than a trough, over Foxe Basin. The primary center of circulation is normally located over the North Pole, but this month it split into several centers.

The last week of the month produced three tropical cyclones, two of which were severe hurricanes--they were David and Frederic. Between the two was tropical storm Elena.

Extratropical Cyclones--The first storm of the month formed near the juncture of the Ohio and Mississippi Rivers on the 1st. It passed over the Great Lakes as a weak LOW on the 2d. On the 4th it was over the Labrador Sea. The storm crossed north of the 5MOU, which was stationary near 51°N, 51°W, with gale winds that shifted from south to northwest between 0000 and 1200. The storm was only 992 mb as it passed south of Iceland on the 5th, but its area of coverage had expanded. At 1200 the UNION PROGRESS felt 66-kn winds southwest of the center. Waves of 15 ft were occurring in both the southeast and southwest quadrants. The MARIE LEONHARDT had 43-kn winds in the southeast quadrant at 1800. On the 6th the storm disappeared as it blended into a LOW to the north.



Monster of the Month--The eastern slopes of the Rocky Mountains produced this storm on the 8th. It moved across the northern United States and produced thundershowers. On the 11th it moved offshore, still produc-

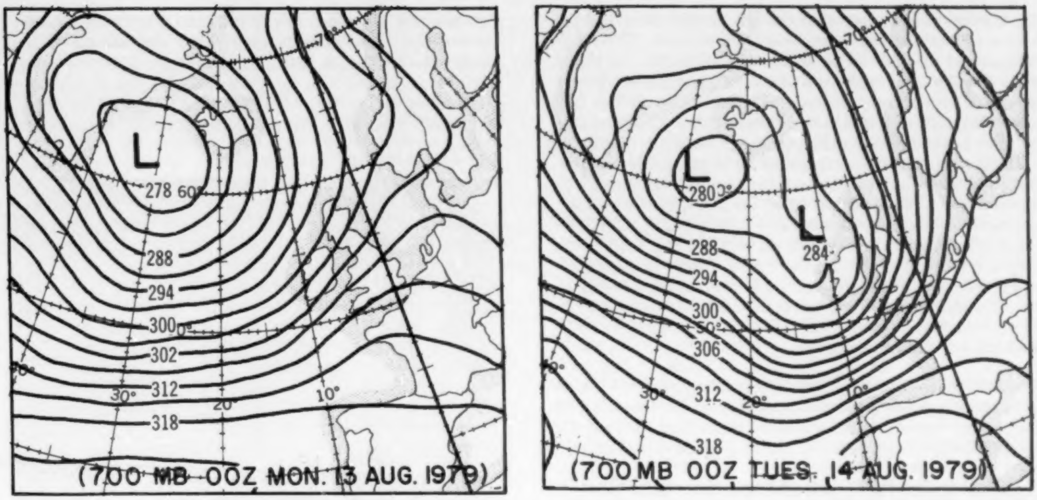


Figure 39. --These upper air charts (700 mb) reflect the rapid deepening over Ireland in 24 hr.

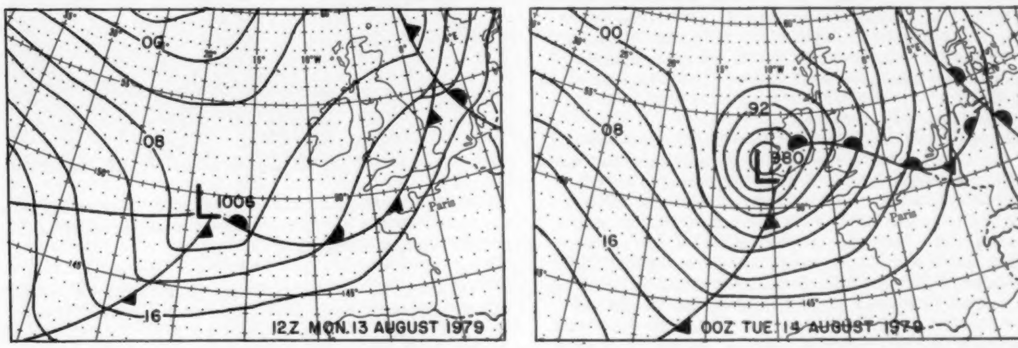


Figure 40. --A comparison of these two surface maps shows the explosive deepening that occurred in 12 hr, from a 1006-mb frontal wave to a 980-mb storm.

ing little except rain showers. It was moving eastward at about 25 kn under zonal flow. At 1200 on the 13th the storm was 1006 mb still as a frontal wave off the Brest peninsula. By 1800 there was an indication of deepening. Ocean Weather Station Romeo had 40-kn winds and 16-ft seas. The HUMACAO (50°N, 16°W) reported 55-kn northwesterly winds and 17-ft seas. At 0000 on the 14th the storm had plunged to 980 mb near Fastnet Rock. Romeo had 20-ft waves.

The storm caught the yachts in the Fastnet race. They had left Cowes on the Isle of Wight on the 11th to race to Fastnet Rock and return to Plymouth. The storm struck as many were rounding Fastnet Rock and sailing toward the Isles of Scilly. The winds blew up to 60 kn with giant seas reported as high as 60 ft. There were 14 lives and 22 yachts lost. Many others were injured and many yachts damaged though not lost. There were 306 yachts in the race crewed by 3,000 yachtsmen. Rescue services saved more than 130 people. At 1200 on the 14th the C.S. ALERT north of Cabo Finisterre had 20-ft seas. Several ships had strong gales. The ATAMAN was in the northwesterly flow not far from OWS Charlie with 44-kn winds and 26-ft swells. Swells of 16 ft extended from OWS Charlie into the Bay of Biscay.

The intensification of the storm was connected with the development of upper air support. At 0000 of the 13th the primary upper air LOW at 700 mb was southwest of Iceland with a quasi-stationary surface LOW. At 0000 on the 14th another LOW, supporting this storm, had developed at 700 mb northwest of Ireland. This allowed rapid strengthening of the surface storm (figs. 39 and 40).

The VOSGES was on the North Sea with 50-kn winds and 39-ft swells at 1800 on the 14th. By the 15th the storm was northeast of the Shetland Islands, bringing its last blows to the North Sea. It continued northward to end over Greenland on the 17th.

This storm mainly affected the Great Lakes as far as ships and marine interests were concerned. It was first analyzed near Lake Athabasca, Canada, on the 11th. It started to get an organized circulation on the 12th as it slowly moved eastward. At 0000 on the 14th it was 997 mb over southern James Bay. On the 14th and 15th there were eight reports of winds greater than 34 kn by U.S. lakers with National Weather Service wind equipment. The highest measured was 40 kn by the CLIFFS VICTORY at 1800 on the 14th on Lake Huron. The highest waves were 8 ft by the LEON FALK JR also on Lake Huron at 0600 on the 15th.

By 1200 on the 15th the LOW was 1002 mb near Anticosta Island and weakening. The storm was southwest of and moving into the circulation of a stronger storm near Kap Farvel. Late on the 16th the Great Lakes storm did not exist.

This storm came out of the southeastern United States and crossed over water near Delaware Bay on the 13th. Two ships reported gales almost immediately. At 1800 the SEALAND MARKET (41°N, 65°W) found 50-kn winds from the south-southwest and 15-ft waves. At 0600 on the 14th the LOW was 986 mb near Sept-Iles. At 1200 a ship east of St. John's had 48-kn southerly winds. On the 15th the weather station at Cartwright measured 40-kn winds. At 1800 the ATAMAN and ATLANTIC PROJECT both near 52°N, 42°W, had winds between 44 and 50 kn. They had 20- to 30-ft seas and 33-ft swells. The storm loitered off the southeast coast of Greenland on the 17th and then disappeared on the 18th.

There was a col area over Baffin Island on the 16th. By the 17th a weak cyclonic circulation could be found on the analysis. Two small LOWs nearby were absorbed into the circulation on the 18th and at 1200 it was 988 mb near 70°N, 70°W. A tight gradient was forming over Baffin Bay. The BAMSA DAN was near 67°N, 55°W, with 44-kn winds out of the south. The seas were 21 ft. At 1800 the KUNUNGUAK (71°N, 52°W) in Umanak Fjord had 37-kn winds off the Icecap and down the fjord. At 0000 on the 19th BAMSA DAN was near the same position and reported 44-kn winds with 30-ft seas; at 0600 she reported 52 kn and 30 ft. The KUNUNGUAK now had 44-kn winds in the fjord. At 1800 on the 19th another ship OXZM had 44-kn winds off Sondre Stromfjord.

The LOW was drifting northward and was over Ellesmere Island on the 20th. On the 22d and 23d it looped southward then northward again and disappeared over the Arctic Ocean on the 24th. It's not likely that there were many ships that far north to report.

During the last 10 days or so of the month the circulations over the North Atlantic were relatively weak and diffuse. Early in the period there was a well-defined cyclonic circulation over the Norwegian Sea and a disorganized storm over Newfoundland. On the 27th 37-kn easterly winds were reported at 74.5°N, 82.6°W, in Lancaster Sound by the Canadian LABRADOR. On the same day a waterspout was spotted off West Palm Beach and a funnel cloud was seen over Galveston Bay.

This storm was not a large one, but there were several significant wind reports. The storm formed off Newfoundland late on the 26th. On the 27th the NOVO MESTO was 200 mi south of the center with 37-kn winds and 12-ft seas. Six hours later at 1800 she had 50-kn winds as did the ORTEGA both in the vicinity of 42°N, 42°W (fig. 41). At 0000 on the 29th the storm was only 1005 mb near 45°N, 28°W. The KAPITAN LEDOCHOWSKI was about 200 mi to the northeast with 45-kn northeasterlies.

Figure 41.--Ships battled winds up to 50 kn in the two small LOWs at the bottom of the photo, near 46°N, 30°W, and 45°N, 42°W.

On the 30th the storm turned northward. It passed almost directly over OWS Lima on the 31st at 1600. By September 1 it was 990 mb south of Iceland, and Icelandic fishing vessels were reporting gales. The storm ended its days over the Norwegian Sea on the 5th.

This storm began at the point of occlusion on a front over Goose Bay on the 31st. The BEN OCEAN LANCER was north of Cape Chidley in the original southeasterly circulation late on the 30th with 42-kn winds. An American ship (KBCG) was a few miles to the east with winds of 37 kn. She was reporting every 3 hr with winds about 40 kn and at 0600 on the 31st had 26-ft seas. The LOW was 986 mb on the first chart of September at 56°N, 57°W. The PELICAN was near Hebron and the KBCG was off the southwest coast of Greenland. Both had 40-kn winds, but from opposite directions. The latter reported 25-ft seas from the southeast. On the 2d the SELFOSS was south of Kap Farvel with 44-kn winds as the LOW reversed its track and turned southeastward. The MANCHESTER CRUSADE found gales with 16-ft waves northwest of the center. The storm finally moved over Iceland into the Norwegian Sea.

Tropical Cyclones--Hurricane David developed on the 26th in the south-central North Atlantic, followed 3 days later by hurricane Frederic. Both storms moved

west-northwestward through the northern Caribbean before recurving northward into the United States. The two storms coexisted from August 29 through September 15.

David developed explosively during the last week in August. By the 29th he was moving through the Martinique Passage with 110-kn winds roaring around his 938-mb center. Dominica was hardest hit as 90-kn plus winds, storm tides, and torrential rains devastated the island, leaving 56 people dead and some 60,000 homeless. On Martinique, Fort St. Louis reported 89-kn winds, while 15-ft seas battered Fort de France. By the 30th David's pressure had dropped to 924 mb with winds estimated at 140 kn. Puerto Rico received the backlash of winds, rain, and storm tides as David passed 70 to 80 mi to the south.

On the 31st, 130-kn winds roared around a 929-mb pressure center. Later in the day David took his fury northwestward across the Dominican Republic coast just west of Santo Domingo. Winds in the capital city climbed above 90 kn before the wind equipment blew down. Central pressure was 926 mb as David made landfall, but he was on a collision course with the rugged mountains of Hispaniola. His Friday night trek brought tragedy and destruction to the island.

While the mountains of the island weakened the storm, they were also responsible for torrential rains, flash floods, and locally accelerated windspeeds. The great killer was floods. They isolated communities, swept villages away, and were mainly responsible for more than 1,000 deaths that have been estimated so far. The port of Santo Domingo was closed for several days to permit soundings in the channels. At the Sea-Land terminal in Rio Haina a rail-mounted container crane collapsed. Most roads were heavily damaged as were the cities of Jarabocoa, San Cristobal, and Bani. In the mountain village of Padre las Casas several hundred people were killed when a church and school they were using as a haven was swept away by a rampaging river. Crop damage was severe and widespread. Almost 70 percent of the crops were destroyed with damage estimated at $350 million.

On the 30th and 31st three U.S. cooperating vessels were in the vicinity of David. They were the CARNIVALE, MAYAGUEZ, and TAMPA. Their positions were between 18.5° and 20°N and 65.3° and 66.2°W, with gale-force winds and waves generally to 12 ft. An exception was the 0600 report of the 31st from the MAYAGUEZ of 45-kn winds, 20-ft seas, and 23-ft swells. At that time she was about 200 mi northeast of David.

Over Labor Day weekend Frederic was spreading heavy rains and strong gusty winds in the Leeward and Virgin Islands, a little north of David's stomping grounds. St. Martin, close to the center, experienced a 58-kn gust on the 3d, while 45-kn wind gusts buffeted Antigua and St. Thomas. St. Croix had a 30-hr rainfall amount of 24 in.

On the morning of September 1 a weakened, somewhat disorganized David showed his eye along the north coast of Haiti. His maximum winds were barely hurricane force. He remained in this state as he crossed the Windward Passage and the eastern tip of Cuba that afternoon. Once over more open waters, David began to reintensify as he headed northwestward. By the 2d 80 kn winds roared around his 980-mb center, which was skirting the western Bahamas. During the afternoon Andros Island reported 60- to 70-kn winds shortly before the eye appeared. Up to 8 in of rainfall was reported in the Bahamas. The GEN SWIERCZEWSKI encountered 50-kn winds as she sailed through the Straits of Florida.

David's winds climbed to 90 kn as he approached southern Florida early on the 3d (Labor Day). A slight northward shift brought David's center about 50 mi east of Miami, where the beaches were buffeted by gale-force winds. Wind gusts of 60 to 70 kn were reported along Florida's east coast as David moved northward. This was accompanied by heavy surf and 2 to 5 in of rain. By evening David's center was on the beach just south of Melbourne. He remained close enough to water to maintain hurricane strength. West Palm Beach reported 50-kn winds with gusts to 65 kn before the power failed; gusts were estimated to have reached 74 kn.

After a short journey over open water on Tuesday (the 4th), David, sporting 80-kn winds, roared across St. Catherine Sound to finally come ashore just south of Savannah Beach, Ga. Savannah recorded 50-kn winds with gusts to 59 kn and a low pressure of 970 mb. Tides were generally 3 ft above normal. Two French students were drowned in the heavy surf off Jekyll Island. To the north gusts along the coast ranged from 50 to 60 kn. Charleston, S.C., reported 49-kn gusts. Tides ran 2 to 5 ft above normal. Several tornadoes were reported between Charleston and Myrtle Beach. Rainfall was heavy in some areas. Savannah received 6 to 7 in, and there were reports of 9 to 10 in of rain in interior South Carolina. Elsewhere, amounts of 2 to 5 in were common. Flooding was light to moderate. However, in North Carolina major flooding was reported on the Lumber River.

On his journey northward as a tropical storm, David continued to spread squalls, with heavy rains and gusty winds, and some tornadoes east and northeast of his center. He made his way through the Carolinas on the 5th. Raleigh and Greensboro, N.C., reported gusts to 31 kn. To the east Elizabeth City was drenched by 8.52 in of rain. Along the coast there was only some minor flooding and beach erosion. By Wednesday night the tropical storm moved through Virginia, Maryland, and into central Pennsylvania. Tornadoes touched down in Maryland, southern and northern Virginia, Pennsylvania, Delaware, and New Jersey. Rainfall amounts ranged up to 8 in, while winds gusted from 30 to 40 kn. Wilmington, Del., recorded a 46-kn gust, while winds at Richmond gusted to 39 kn. Wind and rain were responsible for widespread power outages all along the eastern seaboard. In the New York metropolitan area 2.5 million people were without electricity.

That same day (September 5) the Dominican Republic was bracing itself for a second weather battle in less than 1 week. Frederic had weakened to a tropical storm the day before as he made his way along the northern shore of Puerto Rico, dumping heavy rain and whipping up gales. In the Dominican Republic heavy rains hampered relief operations that had been going on since David. Following David's path Frederic arrived off eastern Cuba on the 7th, a weak depression.

While Frederic struggled across Hispaniola, David finally turned northeastward upon crossing the New York line near Binghampton. As David accelerated through New England, he began to turn extratropical. By late on the 7th he was through New Brunswick,

Newfoundland, and out into the open North Atlantic.

At this time Frederic, still a depression, was malingering along the south coast of Cuba. He finally got it together on the 9th when he regained tropical-storm strength. The following day Fred turned northwestward, crossed western Cuba, and continued to strengthen as he headed for the U.S. Gulf Coast. By late on the 11th his pressure had fallen to 958 mb, winds had climbed to 105 kn, and gales extended 150 mi north of his center, which was located some 375 mi southeast of New Orleans. The next morning, Wednesday the 12th, Frederic was even healthier; 115-kn winds roared around a 945-mb center. Coastal residents from Grand Isle, La., to Panama City, Fla., boarded up homes and businesses. On Wednesday evening all hell broke loose from Pascagoula to Pensacola. Enormous tides, 8 to 12 ft above normal, ran over and sometimes through the barrier islands and up onto the coast and into Mobile Bay. Five- to twelve-foot storm tides flooded Mobile Bay. Winds whipped rain and sea into a frothy blanket along the coast. At Dauphin Island Bridge 125-kn gusts, under a 943-mb pressure, ripped across Grants Pass. At the sea laboratory on the island, gusts reached 103 kn before the equipment blew down. Gusts at Pascagoula reached 110 kn. On top of these winds and tides, fell 7 to 9 in of rain with a few tornadoes. Most of this devastation took place in the dark.

The port of Mobile, normally busy with freighters and tankers, was paralyzed. Power was off. The tanker NORDIC TEXAS, which was in layup at the Alabama Drydock Company, was torn from its moorings and was sunk at the stern on the east bank of Mobile Bay. Shrimp boat manufacturers at Bayou La Batre and Coden were seriously affected. The Ingall's shipyard in Pascagoula sustained extensive damage and was closed for several days.

Frederic marched inland on a northward path and weakened. Gales were accompanied by 2 to 6 in of rain over northern Mississippi, Alabama, and Tennessee. Frederic was a depression by the time he reached Tennessee late on the 13th. During the night he completed an extratropical transformation. He moved up the west side of the Appalachians, through the Tennessee and Ohio Valleys, and into Pennsylvania and New York. The storm dumped 2 to 5 in of rain. Winds were still strong. Latrobe, Pa., recorded a wind gust of 40 kn, while Bridgeport, Conn., was whipped by 43-kn gusts. Buffalo was doused by nearly 4 in of rain as the remnants moved across New York and northern New England late on Friday the 14th.

Frederic's damage has been estimated at more than $1.8 billion in Alabama and Mississippi; $1.25 billion in Alabama alone. Total damage will exceed $2 billion. The death toll in Frederic is eight. Preliminary damage for David has also been estimated at nearly $2 billion, with most of that in the Dominican Republic, where the death toll was estimated at 1,200. In the United States David was responsible for 16 deaths, while Puerto Rico suffered 9.

Shortly before Frederic was spotted on the 29th a tropical depression formed in the central Gulf of Mexico. Located about 500 mi east of Brownsville, the system was moving westward at about 10 kn. Late the following afternoon Elena was christened, about 190 mi southeast of Galveston. Moving west-northwestward, Elena remained a minimal tropical storm. She slowed upon nearing the coast, and winds of gale force were occurring only in squalls. Tracking slowly and erratically northwestward, Elena approached the coast about 75 mi west of Galveston early on the 1st. She quickly dropped to depression strength. Elena was responsible for heavy rains and thundershowers throughout southeastern Texas. Rainfall amounts of 2 to 5 in were reported.

Note: The times in the captions of the radar pictures of figures 39, 40, 42, and 46 of the August Rough Log in the November 1979 issue are given erroneously as EST. They should have read GMT.

Casualties--The Turkish coaster TOROSLAR 1 and the PETUNIA collided in fog on the Black Sea on the 5th. The 433-ton PANDA STAR was stranded in fog on the 8th on a sandy beach of north Portugal. The 499-ton MERCURIUS and the 110-ton XMAS ROSE collided in fog outside of Aberdeen harbor on the 12th. The XMAS ROSE sank, but all the crew was picked up by the MERCURIUS and landed at Aberdeen. The 426-ton ROMARK grounded on the river Tweed on the 17th in thick fog. The 31-ft yacht SEA CHANGE sank in a collision in fog with the barge EXXON NEW YORK in Rhode Island Sound. One man from the yacht was missing, and three were rescued by the tug EXXON OCEAN STATE. The 953-ton CARGO-LINER II arrived in southern France with heavy weather damage that occurred from the 16th to the 19th. The 8,658-ton ferry WINSTON CHURCHILL (cover photo) ran aground outside Gothenburg harbor on the 26th in rough weather. All passengers were rescued. There were over 100 vehicles aboard. No serious injuries were reported, and the ferry was refloated. The 18,907-ton Venezuelan INDEPENDENCIA II claimed heavy weather damage on the 28th on arrival at Milford Haven. The 2,123-ton KAPTAN CELAL with a cargo of coal listed and sank in a storm off the Turkish Black Sea coast near the entrance to Bosporus on the 30th. All the crew was picked up by the Russian SUKHUMI.

Four vessels broke their moorings on the 31st during hurricane David, and were damaged. They were the UNITED STAR (992 tons) at Santo Domingo, and the KALIOPE (4,706 tons), SANTA MARIA (1,190 tons), and the VENTURE STAR (4,225 tons) at Rio Haina.

Other Weather Casualties--The 133,679-ton tanker I.D. SINCLAIR, anchored 11 mi off the South African east coast, was swamped by a mountainous wave on the 9th. One sailor was washed overboard, and four were injured. The tanker suffered no serious damage. Huge swell waves had been occurring. The 10,369-ton SOKAI MARU was 31 mi east of Cape Recife when 11 freight containers were washed overboard in the heavy seas.

Smooth Log, North Pacific Weather

July and August 1979

SMOOTH LOG, JULY 1979--The storms this month had a poor sense of direction. The paths wandered and curved back from their original direction. The primary storm path stretched from Honshu eastward to near midocean and then northeastward into the western Gulf of Alaska. Another track would be from the vicinity of the Date Line and 40°N curving into the Gulf of Alaska. The center of none of the LOWs was able to penetrate inland on the North American coast. One long-lived LOW tracked from China on the 12th to the East Siberian Sea on the 26th.

The climatological monthly normal sea-level pressure pattern for the North Pacific basin indicates only the large Pacific High (fig. 42). Slight troughing is in-

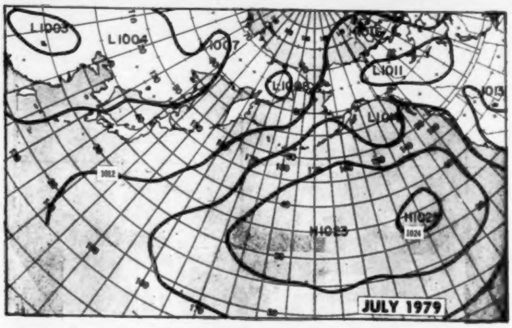


Figure 42.--Mean sea-level pressure, July 1979.

dicated over the Bering Sea. This month's mean showed the 1025-mb Pacific High centered near 34°N, 145°W. A 1014-mb LOW is indicated over the Gulf of Alaska and another 1008-mb LOW over eastern Siberia.

A positive 3-mb anomaly center near the Pribilof Islands split negative values on both sides north of latitude 30°N. The western part was only very slightly negative. The eastern part had a minus 4-mb center near 51°N, 143°W.

The upper-air pattern at 700 mb showed the usual HIGH centered around 30°N and the Date Line. In climatology there is only one LOW centered over the North Pole, but this month there were also two anomalous LOWs, one over the Gulf of Alaska and the other over the Sea of Okhotsk. The troughs off the Asian and North American coasts were more pronounced than in climatology.

There were six tropical cyclones named over the North Pacific, four over the western ocean and two over the eastern ocean. They were typhoons Ellis and Hope and tropical storms Faye and Gordon in the western ocean, and tropical storm Carlos and hurricane Dolores in the eastern ocean.

Extratropical Cyclones--The first week of the month the Pacific High moved westward to near 40°N, 165°W. This allowed the development and intrusion of several LOWs off the United States-Canadian coast. During the second week the HIGH weakened and split into two centers. By the third week it had rejuvenated and was again off the West Coast. During the fourth week it spread westward again, and by the end of the month it was centered near 40°N, 175°W.

The first storm originated as a frontal wave over the Sea of Japan on the 1st. On the 2d a ship reported 13-ft waves well south of the storm's center. At 2300 the EVER SPRING at 35°N, 143°E, measured 38-kn winds, 17-ft seas, and 20-ft swells. By 1200 on the 3d the storm was centered over Ostrov Simushir at 987 mb. The SHUWA MARU was east of the warm front near 44°N, 164°E, with 42-kn southerly winds and 15-ft swell waves. Another Japanese ship 700 mi south of the center had 16-ft waves. On the 4th several ships reported winds near 40 kn and waves of about 15 ft. The highest was again near the warm front (48°N, 166°E) by the ALASKA MARU with 45 kn and 16 ft. The HOHSING ARROW found 25-ft swells near 52°N, 169°E, and the PACIFIC VENTURE near 38°N, 157°E, had 23-ft seas. Gales continued through the 5th as the storm traveled along the Asian coast, gradually weakening to dissipate on the 6th. Saint Paul Island received winds up to 35 mi/h.

As the Pacific High moved westward, a low-pressure area developed off the coast of northern California. A series of LOWs formed and dissipated during the next week, some lasting only a matter of hours. One of these was first noticed on the 0000 chart of the 8th. Another LOW was moving southward from the Gulf of Alaska. At 0000 on the 9th the southern storm was the primary system at 997 mb near 44°N, 137°W. The STUYVESANT (41°N, 128°E) reported 25-ft seas and swells. A British ship near 36°N, 128°W, headed for San Francisco, had 16-ft waves at 1200. At 1800 a SHIP near 42°N, 125°W, was sailing south into 35-kn winds, 16-ft seas, and 30-ft swells. Winds gusted to 76 kn at Priest Rapids Dam in Washington. Late on the 10th this LOW disappeared off the Queen Charlotte Islands, and another developed farther north.

The Pacific High was split into two centers on the 9th over the central ocean. One was over the Bering Sea and the other near 40°N, 170°W. The southern center dropped over 400 mi southward in 12 hr, and a warm front was analyzed between the two HIGHs. On the 10th a wave developed on the warm front. The PRESIDENT TAFT was near the wave with 13-ft waves. On the 11th the TOHBEI MARU had 16-ft swells west of the 997-mb center, which was now near 44°N, 167°W. The KATO in the southwest quadrant had 35-kn gales. At this time this was a relatively small storm, but as it turned southward the circulation expanded and the gradient relaxed even further. At 0600 on the 12th the 9VAJ reported 35-kn southerly winds east of the center. This was the last report approaching gale force prior to the storm's demise on the 14th.

This storm had its beginning over China. It crossed northern Honshu late on the 11th. At 1200 on the 13th the 996-mb storm was near 38°N, 152°E, and the

PRESIDENT MADISON was west of the center at 38°N, 147°E, with 21-ft swell waves from the north. By mid day on the 14th the storm had reverted back to a fronta wave; it disintegrated on the 16th.

This long-lived storm came out of central China. It survived for many days as only an identifiable frontal wave. On the 15th it passed south of Tokyo. The HAKUHO MARU was southeast of the wave with a thunderstorm and 50-kn winds. On the 16th the storm had a large-scale circulation. On the 17th the ELBE EXPRESS was south of the 996-mb center with 13-ft waves. The storm was now traveling northward. During the 18th the storm turned eastward again and moved over the Bering Sea. On the 20th the storm was 992 mb at 59°N, 175°E. The OJI GLORIA (50°N, 166°E) found 42-kn winds, and the TOYOTA MARU (51°N, 176°E) had 35-kn winds and 16-ft waves. On the 21st two ships as far as 600 mi south of the center were in 13-ft swells from this storm. The storm dawdled over the northern Bering Sea until the 25th, when it suddenly raced across the Chukchi Peninsula and into the East Siberian Sea.

On the 11th the Pacific High started moving northward and building. This in conjunction with intensification of the heat LOW over southern California and its trough into northern California greatly increased the pressure gradient off the northern California coast. Ships began reporting northerly gales in that area. On the 13th an Italian ship (38°N, 124°W) had 40-kn winds and 15-ft waves. The PRESIDENT TRUMAN had 35 kn and 16-ft waves. On the 14th the ARCO JUNEAU found 35-kn winds. On the 15th it was the AMERICAN LEGION's turn with 38-kn winds near 35°N, 127°W. The gradient relaxed on the 16th.

This storm came out of the central ocean between 40° and 45°N south of the Fox Islands on the 17th. On the 19th the storm intensified. The ATLANTIC PIONEER (47°N, 151°W) measured 35-kn gales and 20-ft waves. At 1800 the SAMUEL CHASE (46°N, 145°W) had 40-kn southwesterly winds 200 mi east of the 1007-mb center. On the 20th the ORIENTAL MERCHANT and PACIFIC VENTURE had near gale-force winds and 20-ft swells. OWS Papa had 35-kn gales. The storm dissipated on the 21st as it approached the southern coast of Alaska. The Pacific High moved back in, and isolated northerly gales again occurred along the northern California coast.

Monster of the Month--This LOW formed in a col area left behind as a series of frontal waves moved eastward between 35° and 40°N latitude. The 0000 chart of the 25th showed the LOW near 43°N, 170°E. The Japanese JKCQ had 35-kn gales near 38°N, 173°E. The RIVER ROSE was 1.5 mb north of the 996-mb center on the 26th with 39-kn easterly winds. Another ship had 38-kn winds from the north near 49°N, 177°E.

The storm moved along the Aleutian Islands on the 26th and 27th. The ship JLJL had been following the storm on its northeasterly track, and at 1800 on the 27th had 35-kn winds about 300 mi southwest of the center. The waves were 16 ft. On the 28th a ship at 41°N, 159°W, reported 48-kn northwesterly winds to the north of the cold front. The storm now turned southeastward, and by 0000 on the 29th it was 1002 mb near 50°N, 149°W. Two ships northeast of the center reported the highest winds, both out of the northeast. One had 37 kn and the other, near 51°N, 144°W, had 58 kn. At 1800 the CHEVRON HAWAII (54°N, 140°W) had 41-kn southeasterlies. The seas had been relatively calm in comparison to some of the winds reported. This trend was broken by the SANKOSTAR on the 30th by her report from 43°N, 157°W, of 40-kn winds, 26-ft seas, and 30-ft swells. On the 31st this LOW disappeared as another formed farther north in the Gulf. This second LOW dissipated as it touched the coast.

Tropical Cyclones, Eastern Pacific--Carlos, a short-lived tropical storm, came to life on the 14th about 100 mi south of Manzanillo. Winds near his westward-moving center climbed to 45 kn on the 15th. However, as Carlos approached Socorro Island on the 16th. he was weakening rapidly, but the MASON LYKES about 180 mi northeast of the island encountered 40-kn winds from the south with 17-ft waves.

Dolores developed some 300 mi east of Clipperton Island on the 17th. She moved west-northwestward and intensified. Late on the 18th Dolores was a hurricane on a northwesterly course. She crossed the 15th parallel on the 20th near 118°W. She was generating winds up to 90 kn at the time. The following day her winds peaked at 105 kn. The northwesterly course became her downfall. She crossed the 20th parallel at about 0000 on the 22d as a tropical storm, and the 25th parallel near 125°W on the 23d as a tropical depression.

Tropical Cyclones, Western Pacific--Typhoon Ellis formed in the central Philippine Sea around the 1st of the month. He moved toward the west-northwest and reached typhoon strength late on the 2d. Maximum winds climbed to 85 kn before he moved ashore, across northern Luzon, on the 3d. In Manila Bay 990 Vietnamese refugees from the TUNG AN were transferred to a Navy ship for safety. Ellis continued west-northwestward as a tropical storm. He crossed the South China Sea and moved inland southwest of Hong Kong on the 6th.

Faye had a similar lifespan. She began near Truk and ended just north of where Ellis came to life. Faye was a tropical storm at best, from the 3d through the 5th. Maximum winds reached 55 kn on the 5th, just after she breezed by Ulithi and Yap and just before she recurved northward.

Tropical storm Gordon had the honor of acting as a harbinger of the destruction to be visited upon Hong Kong less than a week later. Gordon formed on the 26th near 20°N, 130°E. His west-northwestward course took him through the Luzon Strait and eventually onto the China mainland about 150 mi east-northeast of

Hong Kong. The AMERICAN TRADER and the ASIA HONESTY were both in the Formosa Strait on the 27th with gales and waves up to 10 ft. Gordon's maximum winds reached 55 kn on the 28th, the day before he went aground.

Meanwhile, south of Guam a depression had formed, dissipated, and regenerated. Hope was christened on the 29th near 17°N, 135°E. Her course was west-northwestward. She was a typhoon that same day. The AMERICAN LEGION (16.8°N, 133.5°E) was in the western quadrant at 0000 with 40-kn winds and 10-ft seas. Hope's winds climbed to 75 kn on the 30th, 100 kn on the 31st, and to 130 kn by the 1st. The supertyphoon was headed straight for Hong Kong (fig. 43). As she approached land maximum winds dropped to around 100 kn. Hope, an unsuited name as there ever was, came ashore over the colony on the 2d of August. She caused havoc in the harbor. Some 17 ships dragged anchor and another 10 broke free and collided. The ARGONAUT, a Greek cargo carrier, crashed into the Star Ferry Terminal and wedged itself into the seawall. The 6,300-ton LAMMA ISLAND ran aground as did the refugee ship HUEY FONG. Other refugees, some 500 people, were feared lost in the South China Sea after being turned away from Macao by Portuguese authorities. The refugees were running for Hong Kong in a junk and two flimsy fishing boats.

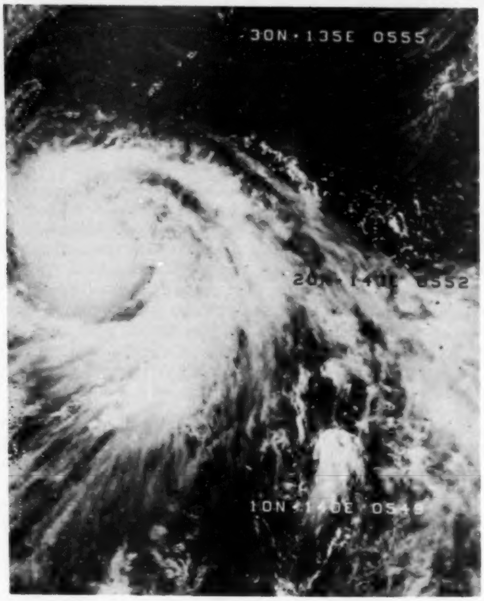


Figure 43.--Supertyphoon Hope west of Hong Kong early on July 31.

The typhoon is the worst to hit the colony since Rose in 1971, when 100 people were killed. Early reports indicate 12 deaths in Hong Kong; six people had already been killed on Taiwan and the Philippines. Damage is estimated in the millions of dollars. About 270 cylinders, each containing about 40 oz of cyanide salt, were washed off a government dockyard by waves during the storm. At last report 123 of the cylinders of the deadly chemical had been recovered. See a related article on typhoon Hope and Hong Kong on page 7.

Hope moved westward across southern China and into Vietnam before dissipating.

Casualties--The 4,009-ton Panamanian HAI HYUN grounded on Apo Reef (12.6°N, 120.5°E) on the 27th. The crew evacuated to an island due to water in the engineroom and rough weather. Wave action was causing the vessel to shake and vibrate. The wind was force 8 to 10 with heavy rain and very rough seas. The crew was picked up by the ORIENTAL EXPERT.

Casualties in the Pacific and Indian Oceans. The 13,819-ton Indian KAIRALI was overdue on July 3 in the Indian Ocean. The weather in that area was 30- to 40-kn west-southwesterly winds in squalls and 13- to 20-ft very rough seas. The British IRON ENDEAVOUR sustained heavy-weather damage on a voyage Port Hedland to Fremantle. The 1,925-ton Indian NANDA DEVI sank at anchor off Karachi when she was swamped by heavy seas. The 7,786-ton British NEW ZEALAND STAR suffered damage to batteries when sea water entered the ventilation pipes during heavy weather from Melbourne to Fremantle. The 5,363-ton ARAB ALHIJAZ reported heavy-weather damage on a voyage from the Persian Gulf to India. The Chilean hopper barge ANGUILA moored near Talcahuano, Chile, was hit by a heavy storm on the 25th. She dragged and ran ashore after her moorings were cut. The 6,336-ton TONG NAM broke in two and sank during heavy weather on the 25th near 29.6°S, 31.7°E. Six of a crew of 38 were rescued.

MOOTH LOG, AUGUST 1979--The number of cyclone centers traversing the North Pacific appeared to be near normal, but the paths they followed did not match climatology so closely. Two storms did follow the primary climatological track from Japan to the Gulf of Alaska as closely as could be expected. The primary storm track out of eastern Asia usually crosses the Gulf of Terpeniya, but this month it was north of Sakhalin Island. These storms generally dissipated as they crossed the Sea of Okhotsk. The Bering Sea had its share of storms; four storms passed through or near the Bering Strait, one from the northwest.

The dominant feature of the mean sea-level pressure for the month was the Pacific High, even though it was weaker than normal (fig. 44). It was broken into

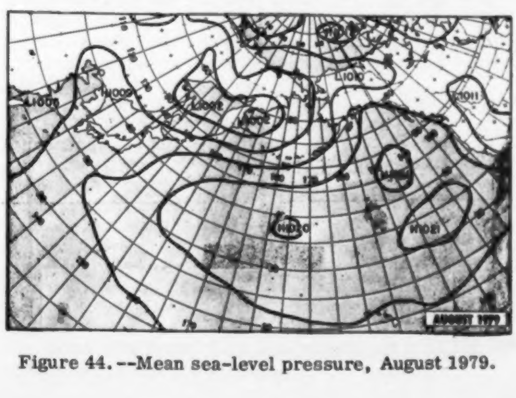


Figure 44.--Mean sea-level pressure, August 1979.

three centers, one of them 1021 mb near 46°N, 145°W. This produced a sharp ridge into Alaska and positive anomalies over the Gulf of Alaska. There was a minus 5-mb anomaly center between Alaska and Hawaii. The normally weak Aleutian Low of 1008 mb was positioned normally east of Kamchatka at 1002 mb. A second 1002-mb low center was over the northern tip of Sakhalin Island. These resulted in a large minus 8-mb anomaly over that area. An anomalous 1009-mb HIGH was over northern Korea.

The long-wave trough at 700 mb was broader this month than the long-term normal. A closed LOW over eastern Siberia replaced the normal trough out of a LOW over the pole. The ridge over western Canada and Alaska was more pronounced this month. Over the northern latitudes the anomaly centers were positive over Alaska and negative over the Sea of Okhotsk. In the middle latitudes the anomalies were smaller and the signs reversed.

There were four tropical cyclones over the North Pacific, hurricanes Enrique and Fefa in the east and typhoons Irving and Judy in the west.

Extratropical Cyclones--Although the Pacific High was the dominant feature of the weather maps covering the North Pacific, it generally did not become well organized with a large, deep center. Instead, it was broken into multiple centers, and when it covered a large area the pressures were not exceptionally high. Several LOWs were able to disrupt it between latitudes 35° and 45°N off the U.S. West Coast. No low-pressure center penetrated the North American coast south of 60°N latitude. One crossed Alaska into Canada. The first few days of the month the Pacific High and a heat LOW over Death Valley resulted in gale-force winds and waves up to 13 ft off the California coast.

The first storm of the month was over the Kamchatka peninsula on the 1st. It drifted northward and then southward on the 3d before resuming a northeasterly track on the 4th. At this time it was 988 mb near Ostrov Beringa. In the meantime the SHINKO MARU had reported 43-kn southerly winds south of Unimak Island on the 3d. On the 4th the ASIA BOTAN near 51°N, 165°W, found 52-kn winds as a small frontal wave developed. On the 5th at 0000 the storm was 995 mb west of Mys Navarin. The ELBE EXPRESS near 54°N, 177°E, had 35-kn winds and 20-ft waves pounding her port beam. The ISOKAZE MARU was farther north at 57°N, 177°W, heading into 40-kn winds and 16-ft waves. The storm moved over the Seward Peninsula and disappeared.

This was another case of a wave forming on a warm front. It was first analyzed late on the 4th over the Sea of Japan. The wave traveled eastward and passed north of a Japanese ship on the 5th producing 13-ft waves. It now turned northeastward as it was diverted by a 1035-mb cell of the Pacific High over midocean. By 0000 of the 8th the storm was 994 mb north of the Rat Islands. The KEA was south of Atka Island with 38-kn winds and 13-ft waves. At 1200 the JAPAN BEAR (48°N, 172°W) had gales. The PACIFIC HIGHWAY at 48°N, 173°W, was southwest of the 987-mb center at 0000 on the 9th with 40-kn winds and 30-ft seas. At 0600 and 1200 the TAUBE and NEW PHOENIX, in the vicinity of 49°N, 170°W, measured 46- and 45-kn winds, respectively, with swells up to 16 ft.

On the 10th the LOW was near the Shumagin Islands and a Japanese ship (JHSE) south of Dutch Harbor had gales and 20-ft swell waves. The fishing vessel DARING south of Unimak Island radioed a weather report of 40-kn northwesterly winds and 8-ft waves. The storm dissipated on the 12th over the Gulf of Alaska.

This LOW formed east of the Kamchatka Peninsula on the 13th on the east side of a continental LOW that stalled over the northern Sea of Okhotsk. On the 14th it was over the central Bering Sea at 988 mb. The gradient near the center was flat, but it tightened in the latitude belt of 45° to 55°N. The MARITIME BRILLIANCE was near the center of that belt near 50°N, 165°W, with 45-kn winds and 12-ft waves. She was sailing westward and on the 15th had 50-kn winds near 172°W with the waves increasing to 15 ft. At 1800 the MOBIL MERIDIAN was near Middleton Island with 43-kn winds. On the 16th the ARCO FAIRBANKS and EXXON NEW ORLEANS also reported 40 kn. Late that day the storm disappeared over Kodiak.

Another LOW that formed east of Kamchatka with a mate on the west side. The wind direction measured on Ostrov Beringa on the 18th tipped off its formation. It immediately was caught in northwesterly upper air flow and followed a track to the southeast. Two Japanese ships had 38-kn winds south of the center near 43°N and the Date Line. The CANADA MARU (43°N, 175°W) reported 40 kn. At 1200 the MAERSK CADET was not far away (42°N, 173°W) with 20-ft waves. The LIPSCOMB LYKES found 38-kn winds on the 20th in that same general area (41°N, 176°W).

The storm was pushing against the 1029-mb Pacific High, and this wasted its energy and led to its defeat on the 22d. Early that day the THOMAS E. CUFFE was in the persistent southerly flow between the pressure centers and found 33-ft swells. The SPRUCE (49°N, 160°W) measured 45-kn winds and 25-ft waves.

The last third of the month the main cell of the Pacific High was over midocean, and the area off the U.S. West Coast supported multiple centers. On the 25th a southwestward trough out of a LOW off northern California expanded southwestward, and a new center formed north of Hawaii. On the 27th the LUCID STAR was west of the 1006-mb center in northeasterly flow with 60-kn winds, thunderstorms, and 21-ft seas.

On the 28th this center dissipated, but another one formed to the west. A ship reported 35-kn winds west of the new center. The PRESIDENT KENNEDY (45°N, 159°W) was north of the center on the 29th with 40-kn northeasterly winds and 13-ft waves. The LOW dissipated as it approached the coast.

As the previous LOW moved westward, another formed nearer midocean on the 29th. It moved southeastward for a more direct alinement with the cut-off upper air LOW. On the 30th the whole system reversed direction and started moving westward. The LUCID STAR was northwest of the center with 39-kn easterly winds and 12-ft seas.

On September 1 the storm turned northward, drawing a frontal system into its circulation. Two ships

had gales, one of them north and the other south of the 998-mb center. By 0000 on the 2d the pressure was 990 mb near 44°N, 171°E. The RIVER ROSE (45°N, 163°E) was in the northerly flow west of the center with 74-kn winds and waves of 26 ft. Other ships including the PRESIDENT JEFFERSON were not far away with gales to 40 kn and waves to 20 ft. On the 3d the JAPAN BEAR near 40°N, 164°E, found 50-kn winds with 23-ft seas and 30-ft swells. The PACIFIC VENTURE was south of the LOW with 35-kn winds and waves up to 23 ft. The LOW had looped counterclockwise around a center near 42°N, 170°E.

On the 4th, 5th, and 6th minimal gales were reported with maximum waves of 23 ft and two isolated 40-kn reports. The storm began loosing strength on the 6th.

Tropical Cyclones, Eastern Pacific--Hurricane Enrique formed on the 17th just west of Clipperton Island. Moving west-northwestward, he reached hurricane strength on the 19th just before crossing the 120th meridian. Winds remained at 65 to 70 kn near his center until the 21st. During the next 2 days Enrique grew explosively as winds climbed to an estimated 125 kn by the 22d. The following day, as Enrique crossed the 20th parallel near 131°W, he began to weaken rapidly. By the 24th he was just a depression.

Meanwhile, hurricane Fefa was also dissipating that same day some 1,200 mi to the east. Fefa had come to life on the 21st near 14°N, 101°W. Taking a west-northwesterly course, she reached hurricane intensity late on the 22d. Winds climbed above 100 kn the following day after Fefa crossed the 115th meridian near 17°N. This only lasted for a brief time. On the 24th Fefa dropped all the way to a tropical depression.

Tropical Cyclones, Western Pacific--Typhoon Irving developed in the friendly confines of the Philippine Sea. First spotted on the 9th, Irving headed westward then north-northwestward. He reached typhoon strength shortly after crossing the 20th parallel near 127°E on the 13th. The following day, sporting 85-kn winds, Irving moved through the southern Ryukyu Islands about 150 mi east of Taipei, Taiwan. The PRESIDENT KENNEDY encountered 30-ft waves south of Okinawa.

While Irving passed far east of the Philippines heavy rains from his circulation swamped about 30 towns in the northern Philippines, resulting in giant mud and rock slides. Six deaths have been reported. In Manila more than 14 in of rain fell in 24 hr. Landslides blocked the main road to the mountain resort of Baguio, where 80 families were evacuated from flooded homes. About 10,000 people were forced to flee their homes. Most of the evacuees were from Bataan across Manila Bay, where seven towns were in waist-deep water. In Taiwan heavy rains flooded low-lying areas in the Taipei suburbs but caused no casualties or serious property damage.

Moving northward through the East China Sea on the 15th and 16th, Irving maintained 90- to 95-kn winds. On the 15th the ALVA MAERSK had 60-kn winds and 38-ft seas, and the PRESIDENT KENNEDY and SEATRAIN LEXINGTON both had 33-ft swell waves. The KOWLOON BAY had 30-ft swell waves in Luzon Strait. On the 17th Irving closed in on South Korea's west coast. South Korea suffered heavy damage, while Irving took off through the Sea of Japan. Along the Russian coast, strong winds and heavy rain disrupted communication and caused flooding around Valdivostok, Spassk, and Ussurisk. Wind gusts reached 74 kn.

Irving weakened as he moved into the Sea of Okhotsk.

While Irving was turning on South Korea on the 17th, typhoon Judy popped up near Guam. She moved west-northwestward, then recurved toward the northwest, and ended in the same general area as Irving. However, Judy became a supertyphoon on the 19th after crossing the 20th parallel near 134°E. At her peak on the 20th, winds near her center were estimated at about 135 kn with gusts to 165 kn and gales extending to as much as 200 mi. A Japanese ship near 24°N, 127°E, had 65-kn winds. Judy moved into the East China Sea about 100 mi southwest of Okinawa on the 22d. The NEPTUNE TOPAZ fought 33-ft swells southeast of Kyushu. Judy's winds had fallen below 90 kn. Naha, Okinawa, reported gusts up to 75 kn; over 4 in of rain fell in 7 hr. Heavy rains reached as far north as Honshu. In Japan Judy was blamed for 11 deaths, mainly due to floods and landslides. Up to 9 in of rain was reported in the northern Alps and the Kamikochi region. The SATSUMA MARU was east of Taipei fighting 51-kn winds, 20-ft seas, and 39-ft swells. On the 24th Judy brushed Shanghai. Although her winds were of minimum typhoon intensity, they along with heavy rains sunk fishing vessels, demolished houses, and triggered floods.

On the 25th and 26th while she was weakening, Judy had enough punch to batter South Korea's southern coastal areas with heavy rainstorms. The nation's three major rail lines closed down after landslides buried part of their tracks. At least 115 people were killed and 35,000 made homeless by floods and landslides. Judy finally blew herself out in the Sea of Japan.

Casualties--The 1,091-ton American fishing vessel BLUE PACIFIC grounded 30 mi from Kodiak on August 5. On the 11th she broke up in heavy winds and swells. A 342-ton American fishing vessel struck rocks in fog at June Island, Alaska. The Liberian-registered SILVER SHELTON (10,039 tons) requested survey of heavy weather damage on the 10th upon arrival at Yokohama. The 70,334-ton Liberian bulkcarrier STOIC ran aground 100 mi north-northeast of Ishigaki on the 19th. The crew was taken off and a salvage tug departed as typhoon Judy passed close by.

Other Casualties--The GULF PROSPERITY sank on the 3d in the Indian Ocean after being battered by a cyclone. The 23 crewmembers were rescued. The Panamanian UNITED FORTRESS grounded near 21.8°N, 90.6°E, in bad weather on the 7th. About a week later it was reported that over 100 fishermen drowned in another storm while returning the 20 mi to shore from looting the vessel. The Taiwanese CHAO FONG sank during a monsoon storm in the Bay of Bengal on the 8th. The Panamanian AL TANVIR was damaged in heavy swell at Matarani Port on the 10th. The Spanish tanker ALCAZAR was towed farther to sea after she lay helpless in mountainous swell 19 mi off Cape Town. She sent a distress call that she was adrift without steering in 45-kn winds. The Pakistani OHRMAZD arrived Kenya reporting heavy weather damage from the 5th to the 13th. The Kuwaiti AWATIF AL SABAH lost anchor and chain at Bhavnagar, India, with strong monsoon winds and currents. The British bulkcarrier ALARIC alleged heavy weather damage between the 13th and 20th upon arrival at Durban on the 22d. The Australian AUSTRALIAN EXPORTER encountered heavy weather on the 25th to the 27th north of New Zealand and lost the port anchor and 11 lengths of cable.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

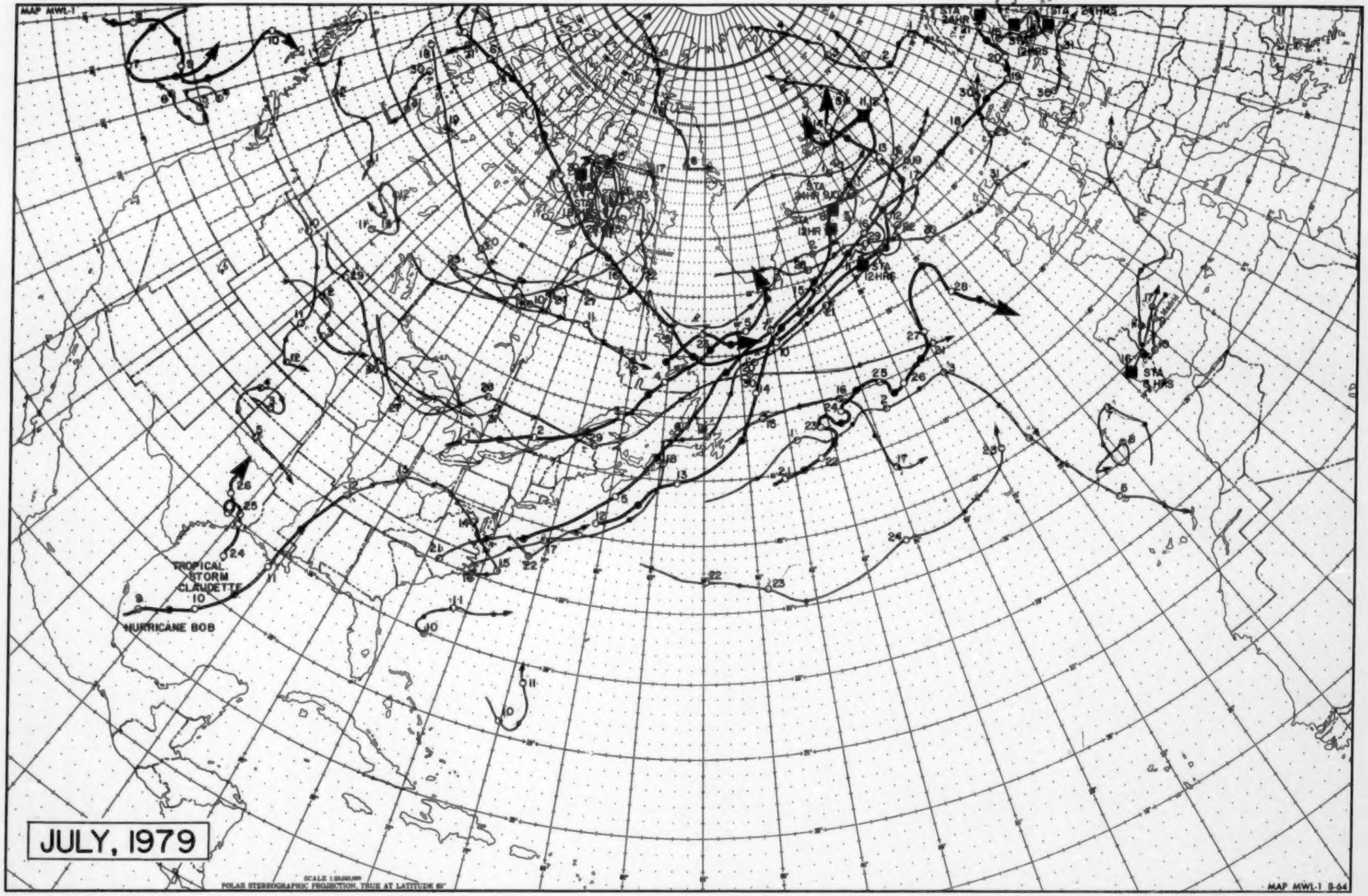


Figure 45.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

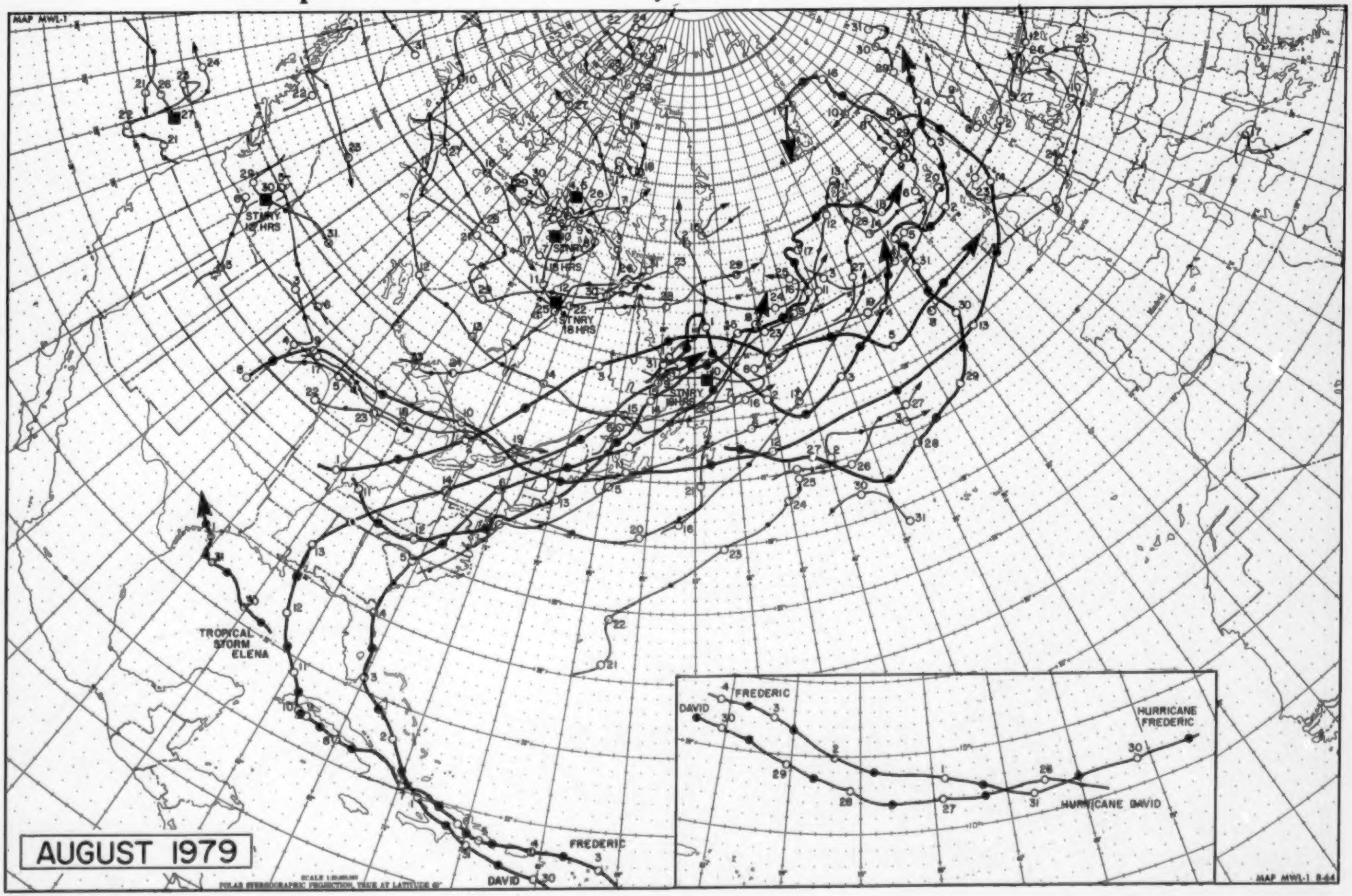


Figure 46.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

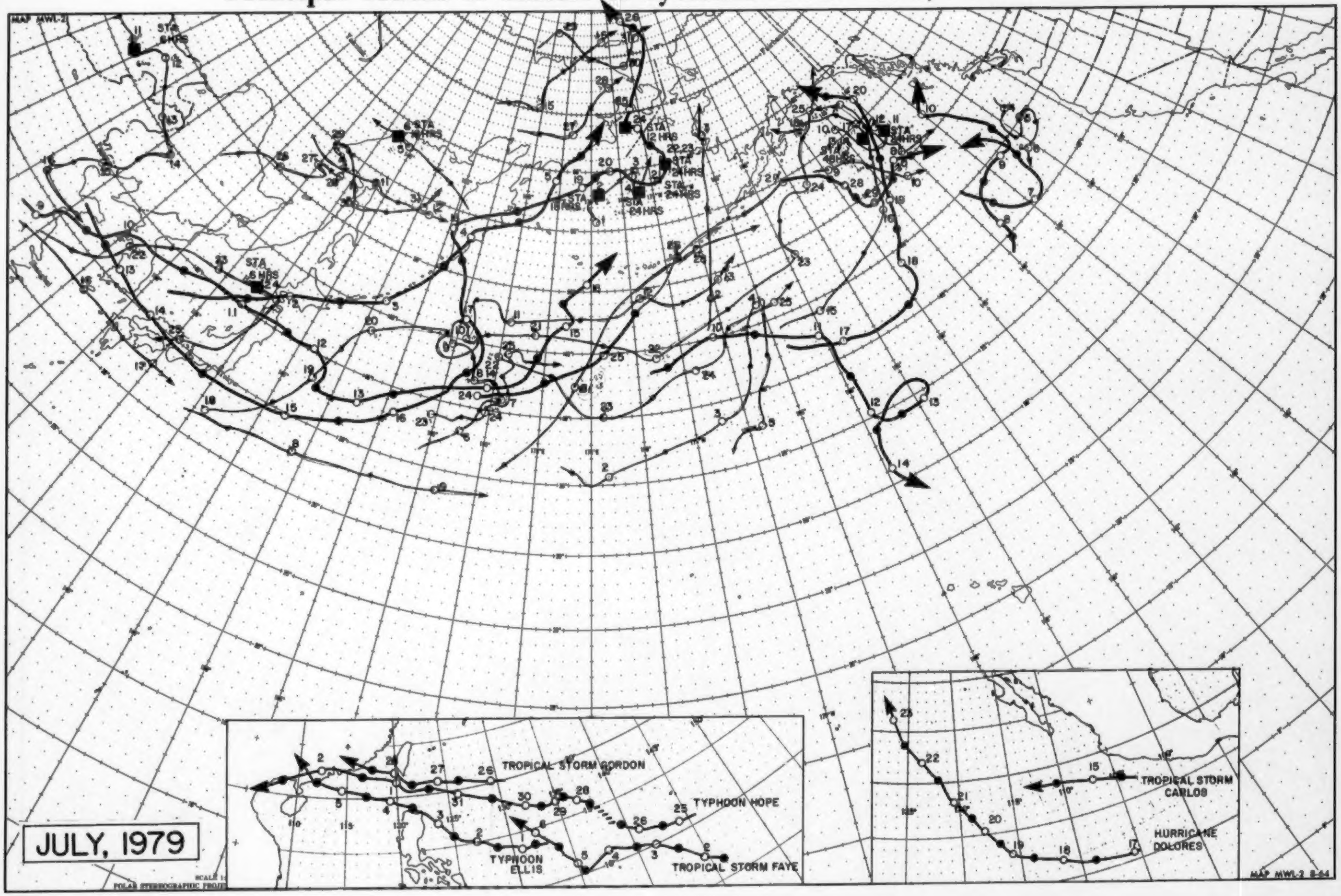


Figure 47.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

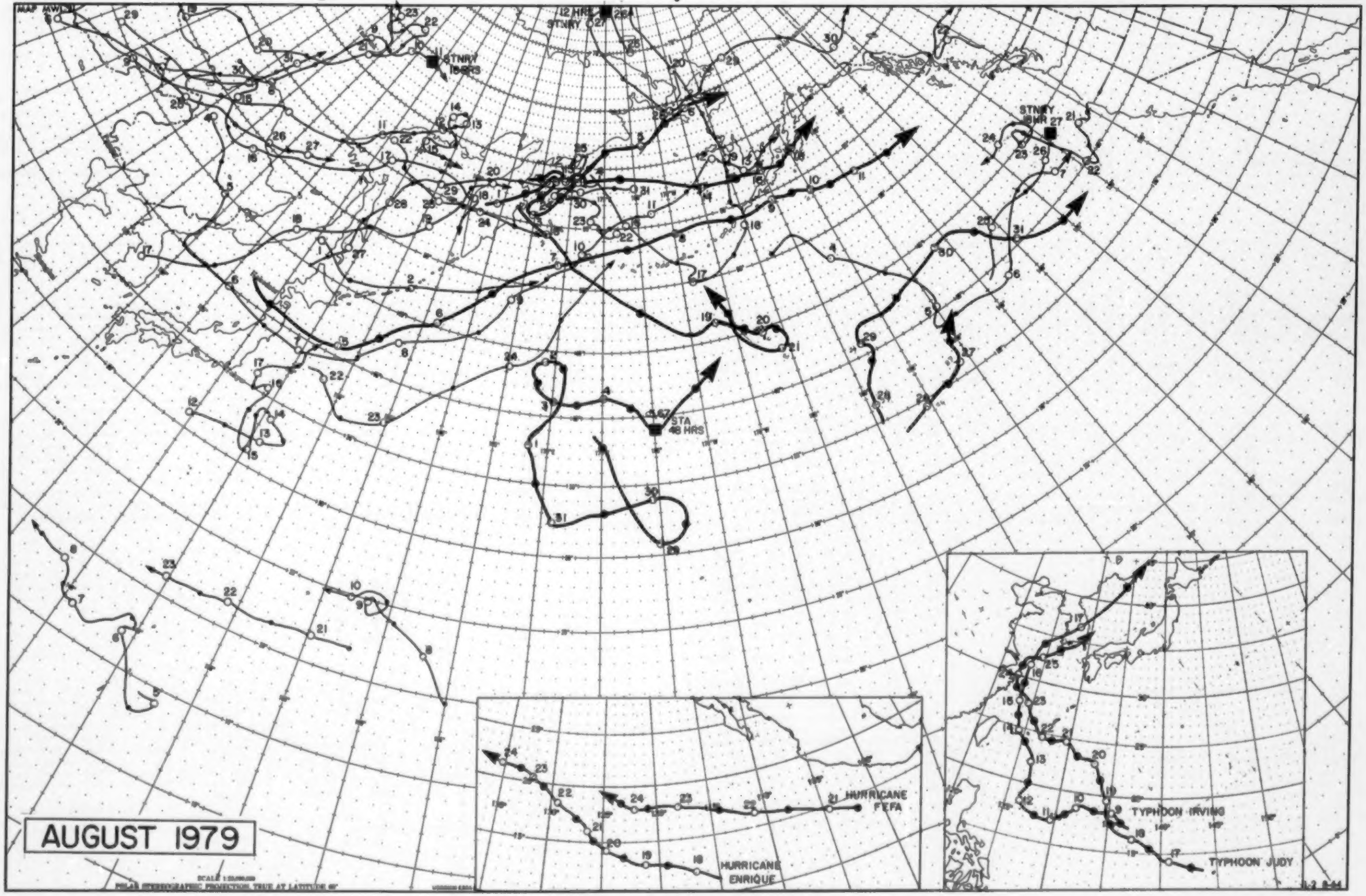


Figure 48.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

U.S. Ocean Buoy Climatological Data

July and August 1979

JULY — DATA SUMMARY — 41002

AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.1	(07 09)	26.4	28.7	(29 21)	245	31
SEA TEMP (DEG C)	24.6	(01 09)	26.9	28.5	(20 21)	245	31
AIR-SEA TEMP (DEG C)	-03.0	(27 18)	-00.5	01.1	(01 21)	245	31
PRESSURE (MBAR)	1011.0	(11 15)	1019.5	1027.2	(24 12)	245	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 245

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.4					.4	5.1
NE		.4	.4				.8	9.0
E		2.9	10.6				13.5	13.7
SE		2.0	2.4				4.5	11.4
S		6.9	12.7				19.6	11.1
SW	.8	17.1	15.9				33.9	11.1
W	.8	9.8	9.8	.8			21.2	11.0
NW	.4	3.7	1.6	.4			6.1	10.0
CALM								
TOTAL	2.0	43.3	53.5	1.2			100.0	11.3

MAX WIND
SPEED: 27 KNOTS
DIRECTION: 250 DEG
DAY: 11
HOUR: 15

AUGUST — DATA SUMMARY — 41002

AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	22.8	(16 12)	26.5	29.0	(06 21)	248	31
SEA TEMP (DEG C)	26.7	(21 12)	27.8	29.9	(14 21)	248	31
AIR-SEA TEMP (DEG C)	-05.0	(13 15)	-01.3	00.4	(20 21)	248	31
PRESSURE (MBAR)	1013.4	(12 12)	1019.6	1024.2	(17 15)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	4.5					5.3	5.9
NE	.4	2.4	2.0	.4			5.3	9.8
E	1.6	6.5	3.2				11.3	7.7
SE	1.2	5.3	6.5				13.0	10.0
S	2.4	2.0	3.6	.8			8.9	9.8
SW	2.4	6.1	10.5	3.2			22.3	13.2
W	3.6	13.4	10.9				27.9	9.2
NW	.8	2.4	.8				4.0	8.0
CALM	2.0						2.0	.0
TOTAL	15.4	42.5	37.7	4.5			100.0	9.7

MAX WIND
SPEED: 28 KNOTS
DIRECTION: 210 DEG
DAY: 12
HOUR: 18

JULY — DATA SUMMARY — 41004

AVERAGE LATITUDE 32.6N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	22.6	(05 06)	26.8	30.2	(31 18)	248	31
SEA TEMP (DEG C)	25.1	(08 03)	26.9	30.5	(31 21)	248	31
AIR-SEA TEMP (DEG C)	-03.0	(05 06)	-00.2	01.9	(05 03)	248	31
PRESSURE (MBAR)	1011.8	(01 09)	1019.1	1026.0	(24 15)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	4.0	1.2				5.6	8.1
NE	.8	.8	4.0				5.6	11.6
E		1.6	12.9				14.5	15.2
SE	2.4	1.6	.8				4.8	6.3
S	2.0	9.3	6.9				18.1	9.0
SW	1.2	7.7	14.5	.8			24.2	12.0
W	.4	8.9	15.3				24.6	11.9
NW		.8	.8				1.6	9.5
CALM	.8						.8	.0
TOTAL	8.1	34.7	56.5	.8			100.0	11.2

MAX WIND
SPEED: 24 KNOTS
DIRECTION: 220 DEG
DAY: 01
HOUR: 09

AUGUST — DATA SUMMARY — 41004

AVERAGE LATITUDE 32.6N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	22.2	(13 12)	27.3	29.6	(30 18)	246	31
SEA TEMP (DEG C)	27.0	(21 12)	28.4	31.0	(06 21)	246	31
AIR-SEA TEMP (DEG C)	-04.8	(13 18)	-01.1	00.7	(22 21)	246	31
PRESSURE (MBAR)	1010.5	(12 09)	1019.1	1025.2	(14 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	1.2	1.6				4.1	9.6
NE	2.0	3.7	3.3				8.9	9.9
E	2.0	8.1	2.0	.8			13.0	8.6
SE	1.2	3.7	1.6				6.5	7.3
S	1.6	10.6	2.4				14.6	7.4
SW	.8	8.5	19.9	.4			29.7	12.5
W	.8	6.1	11.8				18.7	11.0
NW	.4	2.0	.8				3.3	6.9
CALM	1.2						1.2	.0
TOTAL	11.4	43.9	43.5	1.2			100.0	9.9

MAX WIND
SPEED: 22 KNOTS
DIRECTION: 070 DEG
DAY: 16
HOUR: 18

JULY — DATA SUMMARY — 41005

AVERAGE LATITUDE 31.7N — AVERAGE LONGITUDE 079.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	22.5	(25 03)	27.2	29.2	(28 21)	248	31
SEA TEMP (DEG C)	25.8	(01 12)	27.7	29.6	(20 21)	248	31
AIR-SEA TEMP (DEG C)	-05.4	(25 03)	-00.5	01.0	(04 12)	248	31
PRESSURE (MBAR)	1011.8	(01 09)	1018.1	1024.4	(24 15)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	3.2	.4				4.8	5.4
NE		.8	2.0	.8			3.6	15.1
E		2.0	10.9	.8			13.7	17.1
SE		.4	4.0				4.4	15.2
S	.4	8.9	14.9				24.2	11.1
SW	2.0	10.9	16.1	.4			29.4	11.0
W	.8	6.9	10.1				17.7	12.1
NW		1.2					1.2	7.7
CALM	.8						.8	.0
TOTAL	5.2	34.3	58.5	2.0			100.0	12.0

MAX WIND
SPEED: 25 KNOTS
DIRECTION: 030 DEG
DAY: 10
HOUR: 21

AUGUST — DATA SUMMARY — 41005

AVERAGE LATITUDE 31.7N — AVERAGE LONGITUDE 079.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.6	(12 18)	27.3	29.4	(06 21)	247	31
SEA TEMP (DEG C)	26.6	(19 00)	28.3	30.3	(23 18)	247	31
AIR-SEA TEMP (DEG C)	-04.5	(02 12)	-00.9	00.4	(22 06)	247	31
PRESSURE (MBAR)	1009.8	(12 09)	1018.0	1023.8	(14 15)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.6	3.6	1.2	.4			6.9	6.9
NE	2.4	3.6	2.8	.8			9.7	9.4
E	2.4	4.5	2.8	.4			10.1	8.6
SE	1.2	8.1	2.0				11.3	7.7
S	2.8	8.5	5.7				17.0	8.2
SW	1.2	10.9	11.7	.8			24.7	11.3
W	1.2	7.7	6.9	.4			16.3	10.3
NW		2.0	.4				2.4	8.8
CALM	1.6						1.6	.0
TOTAL	14.6	49.0	33.6	2.8			100.0	9.2

MAX WIND
SPEED: 24 KNOTS
DIRECTION: 070 DEG
DAY: 17
HOUR: 15

JULY — D A T A S U M M A R Y — 42001

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	25.1	(10 15)	28.2	29.7	(20 21)	246	31
SEA TEMP (DEG C)	27.2	(27 03)	28.5	30.3	(20 21)	245	31
AIR-SEA TEMP (DEG C)	-03.2	(24 15)	-00.4	01.2	(12 21)	245	31
PRESSURE (MBAR)	1004.8	(11 03)	1016.0	1020.8	(16 18)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N			.4				.4	11.0
NE		2.0	2.4	.4			4.9	12.5
E	.4	10.2	4.1				14.6	8.8
SE	2.8	15.9	11.8	.4			30.9	9.8
S	1.6	11.8	16.7	6.1			36.2	13.9
SW	.4	2.0	2.0	1.6			6.1	14.2
W	.8	.4	.4	.4			2.0	10.4
NW		.8					.8	6.5
CALM	4.1						4.1	.0
TOTAL	10.2	43.1	37.8	8.9			100.0	11.1

NO. OF OBS: 246

MAX WIND
SPEED: 30 KNOTS
DIRECTION: 2:0 DEG
DAY: 11
HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	50.0	34.8	12.2	2.0	1.2				1.0M	4.5M	(11 03)

AUGUST — D A T A S U M M A R Y — 42001

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	24.4	(30 18)	28.2	30.2	(02 00)	132	17
SEA TEMP (DEG C)	27.6	(31 18)	29.3	31.4	(21 21)	132	17
AIR-SEA TEMP (DEG C)	-04.2	(24 00)	-01.1	00.7	(31 15)	132	17
PRESSURE (MBAR)	1008.1	(29 09)	1014.6	1019.9	(01 18)	132	17

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.8	.8				1.5	10.0
NE	1.5	4.5	3.0				9.1	8.6
E	6.1	32.6	17.4				56.1	8.8
SE	2.3	12.1	3.0				17.4	7.1
S	2.3	5.3	3.8	.8			12.1	9.1
SW			.8				.8	11.0
W	.8	.8					1.5	5.6
NW								
CALM	1.5						1.5	.0
TOTAL	14.4	56.1	28.8	.8			100.0	8.4

NO. OF OBS: 132

MAX WIND
SPEED: 22 KNOTS
DIRECTION: 180 DEG
DAY: 30
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 132

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	81.8	15.9	2.3						.5M	2.0M	(30 18)

JULY — D A T A S U M M A R Y — 42002

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 093.5W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DPYS WITH DATA
AIR TEMP (DFG C)	23.8	(10 00)	28.2	30.9	(19 21)	245	31
SEA TEMP (DEG C)	28.0	(02 12)	29.0	32.1	(19 21)	245	31
AIR-SEA TEMP (DEG C)	-04.7	(10 00)	-00.8	00.3	(25 15)	245	31
PRESSURE (MBAR)	1004.7	(23 09)	1014.5	1020.6	(16 15)	245	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	2.0	2.4	.4			6.1	9.2
NE	.4	4.1	2.4	.4			7.3	10.9
E	.8	9.8	8.6	.4			19.6	10.6
SE	.4	11.0	18.8	.4			30.6	12.1
S	.8	4.9	15.5	3.7			24.9	15.3
SW	.8	1.6	1.6	1.6			5.7	14.3
W	1.2		1.2				2.4	9.2
NW	.4	1.6	.4				2.4	6.0
CALM	.8						.8	.0
TOTAL	6.9	35.1	51.0	6.9			100.0	12.1

NO. OF OBS: 245

MAX WIND
SPEED: 30 KNOTS
DIRECTION: 210 DEG
DAY: 24
HOUR: 09

AUGUST — D A T A S U M M A R Y — 42002

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 093.5W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.6	(27 18)	28.4	30.4	(22 00)	246	31
SEA TEMP (DEG C)	28.6	(28 06)	29.6	32.2	(12 21)	246	31
AIR-SEA TEMP (DEG C)	-05.4	(31 12)	-01.2	00.3	(13 15)	246	31
PRESSURE (MBAR)	1007.8	(31 09)	1015.2	1020.5	(14 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	1.2	.8				2.4	8.9
NE	1.2	1.2	.4				2.8	6.1
E	1.6	15.4	8.5	.4			26.0	9.6
SE	1.6	15.4	15.4				32.5	9.7
S	2.4	18.7	3.7	1.2			26.0	8.2
SW	2.0	2.4	.4	.8			5.7	8.2
W		.8					.8	7.1
NW		1.2					1.2	7.3
CALM	2.4						2.4	.0
TOTAL	11.8	55.5	28.3	2.4			100.0	8.8

NO. OF OBS: 246

MAX WIND
SPEED: 24 KNOTS
DIRECTION: 110 DEG
DAY: 27
HOUR: 15

JULY — D A T A S U M M A R Y — 42003

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 086.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.8	(23 21)	28.3	29.6	(13 21)	228	31
SEA TEMP (DEG C)	28.8	(29 00)	29.4	31.0	(17 21)	228	31
AIR-SEA TEMP (DEG C)	-05.3	(23 21)	-01.1	00.3	(11 15)	228	31
PRESSURE (MBAR)	1009.3	(22 09)	1017.5	1021.5	(06 15)	228	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.2					2.2	6.2
NE	.9	8.3	2.6				11.8	8.1
E	4.4	21.1	18.4	.4			44.3	9.8
SE	3.1	7.0	13.6	.9			24.6	11.8
S	1.3	3.1	8.8	.9			14.0	14.2
SW	1.3	.4	.4				2.2	4.8
W	.9						.9	1.6
NW								
CALM								
TOTAL	11.8	42.1	43.9	2.2			100.0	10.4

NO. OF OBS: 228

MAX WIND
SPEED: 27 KNOTS
DIRECTION: 190 DEG
DAY: 23
HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 219

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	48.9	33.8	16.4	.9					1.0M	3.0M	(24 18)

AUGUST — D A T A S U M M A R Y — 42003

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 086.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.9	(22 12)	28.4	30.0	(18 21)	210	30
SEA TEMP (DEG C)	28.8	(28 15)	28.9	30.7	(02 21)	210	30
AIR-SEA TEMP (DEG C)	-05.4	(22 12)	-01.1	00.0	(10 00)	210	30
PRESSURE (MBAR)	1009.9	(29 09)	1016.9	1021.7	(09 18)	210	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.4					2.4	7.2
NE	2.9	10.5	7.1				20.5	8.1
E	3.8	31.4	16.7				51.9	8.9
SE	2.4	5.7	7.1				15.2	9.9
S	1.4	1.9	.5				3.8	6.2
SW		2.9	.5				3.3	7.9
W	.5	1.0					1.4	4.3
NW	.5						.5	1.0
CALM	1.0						1.0	.0
TOTAL	12.4	55.7	31.9				100.0	8.5

NO. OF OBS: 210

MAX WIND
SPEED: 21 KNOTS
DIRECTION: 140 DEG
DAY: 28
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 210

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	75.2	23.3	1.4						.6M	2.0M	(28 21)

JULY — DATA SUMMARY — 42005

AVERAGE LATITUDE 30.0N — AVERAGE LONGITUDE 085.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.9	(13 00)	27.6	29.7	(17 00)	246	31
SEA TEMP (DEG C)	27.4	(01 12)	28.7	30.0	(06 18)	245	31
AIR-SEA TEMP (DEG C)	-04.7	(13 00)	-01.1	01.1	(02 00)	245	31
PRESSURE (MBAR)	1010.7	(01 00)	1017.3	1021.9	(07 06)	245	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	1.2	1.6	.4			3.7	12.3
NE	.4	4.9	3.7				9.0	9.8
E	.4	3.3	8.2				11.8	12.7
SE	.4	6.9	11.4	.4			19.2	12.1
S	.8	8.2	5.7	.4			15.1	10.5
SW	1.2	6.9	7.8	.4			16.3	10.6
W	1.2	10.6	8.6				20.4	9.3
NW		2.4	1.2				3.7	9.4
CALM	.8						.8	.0
TOTAL	5.7	44.5	48.2	1.6			100.0	10.7

NO. OF OBS: 245

MAX WIND
SPEED: 27 KNOTS
DIRECTION: 350 DEG
DAY: 15
HOUR: 21

JULY — DATA SUMMARY — 44001

AVERAGE LATITUDE 38.7N — AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	16.6	(06 03)	22.5	27.2	(29 18)	247	31
SEA TEMP (DEG C)	19.4	(01 12)	22.7	26.5	(31 21)	247	31
AIR-SEA TEMP (DEG C)	-03.3	(05 03)	00.0	02.3	(13 18)	247	31
PRESSURE (MBAR)	1005.7	(05 00)	1016.9	1027.5	(07 18)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	4.0	5.7				10.1	11.1
NE		1.2	.4	.4			2.0	12.0
E	1.6	8.9	1.6				12.1	7.5
SE	2.0	8.1	.4				10.5	6.3
S	2.0	10.5	3.2				15.8	7.1
SW	1.2	7.3	6.9				15.4	10.2
W	1.2	10.1	8.1				19.4	9.2
NW	.8	5.7	3.6				10.1	9.4
CALM	4.5						4.5	.0
TOTAL	13.8	55.9	30.0	.4			100.0	8.4

NO. OF OBS: 247

MAX WIND
SPEED: 23 KNOTS
DIRECTION: 030 DEG
DAY: 05
HOUR: 03

JULY — DATA SUMMARY — 44002

AVERAGE LATITUDE 40.1N — AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.3	(05 00)	22.0	26.0	(31 21)	247	31
SEA TEMP (DEG C)	18.8	(06 12)	22.1	25.9	(31 21)	247	31
AIR-SEA TEMP (DEG C)	-04.4	(05 00)	-00.1	02.5	(13 18)	247	31
PRESSURE (MBAR)	1006.7	(02 21)	1016.4	1026.4	(07 18)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.8	4.0	2.8				9.7	7.9
NE	.8	3.2	.8				4.9	6.8
E	1.6	8.9	1.6				12.1	6.5
SE	1.2	8.9	.8				10.9	6.3
S	.8	6.1	.8				7.7	6.6
SW	1.2	12.6	9.7				23.5	9.6
W	1.6	15.0	7.7				24.3	9.0
NW	1.2	2.0	2.4				5.7	9.6
CALM	1.2						1.2	.0
TOTAL	12.6	60.7	26.7				100.0	8.1

NO. OF OBS: 247

MAX WIND
SPEED: 19 KNOTS
DIRECTION: 330 DEG
DAY: 05
HOUR: 15

AUGUST — DATA SUMMARY — 42005

AVERAGE LATITUDE 30.0N — AVERAGE LONGITUDE 085.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.9	(24 15)	27.8	30.6	(20 18)	244	31
SEA TEMP (DEG C)	28.3	(02 15)	29.3	30.8	(20 21)	244	31
AIR-SEA TEMP (DEG C)	-05.4	(24 15)	-01.6	00.6	(20 18)	244	31
PRESSURE (MBAR)	1011.6	(12 09)	1017.0	1023.3	(14 15)	244	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	3.3	2.0				6.1	9.6
NE	.8	5.7	2.9				9.4	8.5
E	1.2	9.0	7.8				18.0	9.3
SE	1.2	5.7	4.9				11.9	9.4
S	3.3	11.1	2.5				16.8	7.1
SW	1.2	9.0	6.1				16.4	9.1
W	1.6	7.4	4.9				13.9	8.6
NW	1.2	3.7	1.2				6.1	7.6
CALM	1.2						1.2	.0
TOTAL	12.7	54.9	32.4				100.0	8.6

NO. OF OBS: 244

MAX WIND
SPEED: 21 KNOTS
DIRECTION: 280 DEG
DAY: 01
HOUR: 15

AUGUST — DATA SUMMARY — 44001

AVERAGE LATITUDE 38.7N — AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	16.9	(16 12)	23.6	27.8	(06 03)	247	31
SEA TEMP (DEG C)	19.3	(21 21)	24.1	28.2	(04 21)	247	31
AIR-SEA TEMP (DEG C)	-07.1	(13 12)	-00.5	02.4	(24 15)	247	31
PRESSURE (MBAR)	1007.8	(13 06)	1017.1	1024.9	(17 15)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	4.5	4.0	2.0			11.7	12.3
NE	.4	2.8	2.4				5.7	10.1
E		6.5					6.5	5.8
SE	1.2	2.8	.4				4.5	6.1
S	2.0	7.7	7.7				17.4	9.6
SW	1.6	10.1	15.4	.8			27.9	11.6
W	2.0	7.7	6.9	.4			17.0	10.6
NW	.8	2.8	1.6	.4			5.7	9.3
CALM	3.6						3.6	.0
TOTAL	13.0	44.9	38.5	3.6			100.0	9.9

NO. OF OBS: 247

MAX WIND
SPEED: 28 KNOTS
DIRECTION: 020 DEG
DAY: 13
HOUR: 06

AUGUST — DATA SUMMARY — 44002

AVERAGE LATITUDE 40.1N — AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.6	(13 12)	21.9	27.0	(06 21)	247	31
SEA TEMP (DEG C)	18.5	(19 15)	21.9	27.2	(06 21)	247	31
AIR-SEA TEMP (DEG C)	-03.8	(13 09)	00.0	02.6	(25 09)	247	31
PRESSURE (MBAR)	1007.7	(10 21)	1016.4	1024.4	(17 15)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	3.6	4.5				8.9	10.1
NE		.8	3.2	2.0			6.1	18.1
E	.4	3.2	1.6	1.2			6.5	13.4
SE	1.2	2.0					3.2	4.4
S	1.2	8.9	10.9				21.1	10.0
SW	2.4	12.6	15.8				30.8	10.7
W	.4	8.9	4.9				14.2	9.5
NW	.8	4.5	3.2	.4			8.9	10.5
CALM	.4						.4	.0
TOTAL	7.7	44.5	44.1	3.6			100.0	10.7

NO. OF OBS: 247

MAX WIND
SPEED: 27 KNOTS
DIRECTION: 050 DEG
DAY: 12
HOUR: 15

JULY — DATA SUMMARY — 44005
AVERAGE LATITUDE 42.7N — AVERAGE LONGITUDE 068.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	12.9	(05 09)	18.1	21.8	(21 18)	244	31
SEA TEMP (DEG C)	15.3	(06 15)	18.2	21.9	(31 21)	244	31
AIR-SEA TEMP (DEG C)	-03.3	(31 00)	-00.1	02.6	(04 03)	244	31
PRESSURE (MBAR)	1002.5	(03 06)	1016.4	1023.9	(08 03)	244	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 244

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	1.6	.8				3.7	5.9
NE		2.0	1.6				3.7	9.9
E	.8	2.9	1.2				4.9	7.6
SE		4.9	3.3	.4			8.6	10.2
S	.8	15.2	11.5				27.5	9.7
SW	.4	14.3	18.9				33.6	10.9
W	.8	6.6	5.3				12.7	10.2
NW		2.0	3.3				5.3	12.2
CALM								
TOTAL	4.1	49.6	45.9	.4			100.0	10.1

MAX WIND
SPEED: 22 KNOTS
DIRECTION: 140 DEG
DAY: 01
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 155

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	37.4	61.9	.6						.9M	2.0M	(01 21)

JULY — DATA SUMMARY — 45001
AVERAGE LATITUDE 48.0N — AVERAGE LONGITUDE 087.6W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	04.3	(11 12)	07.6	11.9	(24 18)	247	31
SEA TEMP (DEG C)	02.5	(03 09)	04.0	08.8	(27 21)	247	31
AIR-SEA TEMP (DEG C)	00.4	(28 03)	03.6	07.6	(15 00)	247	31
PRESSURE (MBAR)	1002.7	(14 09)	1015.8	1028.8	(16 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.8	10.5	1.2				14.6	6.4
NE	2.8	4.9	1.2				8.9	6.4
E	2.0	3.6	.4				6.1	5.1
SE	2.0	12.1					14.2	5.9
S	1.6	10.5	.8				13.0	6.5
SW	2.0	12.1	4.9				19.0	8.0
W	2.8	9.3	2.4				14.6	6.9
NW	3.6	4.9					8.5	5.1
CALM	1.2						1.2	.0
TOTAL	21.1	68.0	10.9				100.0	6.4

MAX WIND
SPEED: 14 KNOTS
DIRECTION: 240 DEG
DAY: 15
HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	90.2	9.8							.3M	1.5M	(15 21)

JULY — DATA SUMMARY — 46001
AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.1	(02 06)	12.0	13.8	(31 21)	246	31
SEA TEMP (DEG C)	08.8	(01 18)	11.8	14.5	(15 03)	246	31
AIR-SEA TEMP (DEG C)	-01.2	(15 03)	00.1	02.3	(03 15)	246	31
PRESSURE (MBAR)	0987.3	(10 15)	1013.2	1023.3	(15 08)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	4.1	12.6	.4			17.9	12.1
NE	.4	3.7	14.2	.4			18.7	12.8
E		4.1	4.5				8.5	11.6
SE		1.6	2.0	2.0			5.7	16.8
S		2.0	3.3	1.2			6.5	14.5
SW	.4	1.2	3.7				5.3	11.7
W	.4	2.8	23.2	1.6			28.0	15.7
NW		.8	8.1	.4			9.3	17.0
CALM								
TOTAL	2.0	20.3	71.5	6.1			100.0	14.1

MAX WIND
SPEED: 28 KNOTS
DIRECTION: 130 DEG
DAY: 24
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	4.5	63.8	28.7	2.0					1.5M	3.0M	(25 15)

AUGUST — DATA SUMMARY — 44005
AVERAGE LATITUDE 42.7N — AVERAGE LONGITUDE 068.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.7	(23 06)	18.5	22.9	(04 00)	246	31
SEA TEMP (DEG C)	16.7	(16 12)	19.0	22.6	(06 00)	246	31
AIR-SEA TEMP (DEG C)	-04.3	(11 12)	-00.5	02.1	(11 00)	246	31
PRESSURE (MBAR)	1004.0	(11 00)	1016.3	1024.1	(23 12)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	3.7	6.5				10.6	11.8
NE	.8	3.3	.8	1.6			6.5	12.3
E		2.0	.8				2.8	8.7
SE	.4	2.8	2.4				5.7	10.6
S	.4	6.9	11.8	.4			19.5	12.3
SW	.4	7.3	18.7	2.8			29.3	14.2
W	.4	6.1	6.9	.4			13.8	11.8
NW	.8	4.1	4.9	.8			10.6	10.9
CALM	1.2						1.2	.0
TOTAL	4.9	36.2	52.6	6.1			100.0	12.2

MAX WIND
SPEED: 28 KNOTS
DIRECTION: 210 DEG
DAY: 10
HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 164

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	22.6	67.1	10.4						1.1M	2.5M	(15 00)

AUGUST — DATA SUMMARY — 45001
AVERAGE LATITUDE 48.0N — AVERAGE LONGITUDE 087.6W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.1	(14 06)	11.6	14.7	(27 21)	246	31
SEA TEMP (DEG C)	07.2	(01 12)	09.5	12.0	(28 00)	246	31
AIR-SEA TEMP (DEG C)	-00.6	(14 06)	02.1	04.8	(03 00)	246	31
PRESSURE (MBAR)	0999.5	(29 12)	1013.9	1030.1	(15 18)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	2.4	1.2				4.5	7.4
NE	.4	2.0					2.4	4.7
E	.8	5.3	1.6				7.7	7.1
SE	2.4	8.5	6.5				17.5	8.1
S	3.7	15.9	4.1				23.6	7.1
SW	1.2	7.3	.8				9.3	7.2
W	3.3	11.0	5.3				19.5	7.8
NW	2.4	8.9	3.7				15.0	8.2
CALM	.4						.4	.0
TOTAL	15.4	61.4	23.2				100.0	7.5

MAX WIND
SPEED: 20 KNOTS
DIRECTION: 310 DEG
DAY: 14
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	67.9	29.3	2.8						.6M	2.5M	(14 15)

AUGUST — DATA SUMMARY — 46001
AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.7	(23 21)	13.0	14.5	(03 03)	248	31
SEA TEMP (DEG C)	12.5	(11 15)	13.4	14.5	(03 03)	248	31
AIR-SEA TEMP (DEG C)	-02.0	(24 00)	-00.3	00.4	(28 06)	248	31
PRESSURE (MBAR)	0987.5	(18 06)	1015.2	1026.3	(22 03)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.4					2.4	8.2
NE	.8	.8	.8				2.4	6.5
E		1.2	.8				2.0	10.0
SE		3.2	12.1	5.6			21.0	18.5
S	.4	4.0	14.9	.8			20.2	14.8
SW		4.4	8.9				13.3	13.0
W	1.2	8.5	22.6				32.3	12.6
NW		3.2	2.8				6.0	10.4
CALM	.4						.4	.0
TOTAL	2.8	27.8	62.9	6.5			100.0	13.8

MAX WIND
SPEED: 31 KNOTS
DIRECTION: 150 DEG
DAY: 09
HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 248

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	1.6	76.2	18.5	3.2	.4				1.9M	4.0M	(09 21)

JULY — DATA SUMMARY — 46002

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.1	(07 18)	15.5	18.4	(31 06)	246	31
SEA TEMP (DEG C)	15.3	(03 15)	16.5	19.3	(31 21)	246	31
AIR-SEA TEMP (DEG C)	-02.8	(07 18)	-01.1	00.5	(08 15)	246	31
PRESSURE (MBAR)	0998.3	(09 18)	1019.7	1027.6	(18 21)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.8	42.3	.8			43.9	17.1
NE		.4					.4	4.0
E								
SE	.4						.4	3.0
S	.4	4.1	5.3	2.0			11.8	14.3
SW		9.8	8.1	.4			18.3	10.8
W	.4	7.3	5.7	.4			13.8	10.3
NW		2.8	7.7	.8			11.4	14.5
CALM								
TOTAL	1.2	25.2	69.1	4.5			100.0	14.3

MAX WIND
SPEED: 27 KNOTS
DIRECTION: 160 DEG
DAY: 09
HOUR: 00

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	1.2	58.5	31.3	8.9					1.7M	3.5M	(09 06)

JULY — DATA SUMMARY — 46003

AVERAGE LATITUDE 52.0N — AVERAGE LONGITUDE 156.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.8	(05 18)	11.1	13.4	(19 03)	244	31
SEA TEMP (DEG C)	08.9	(01 18)	11.2	13.2	(19 03)	244	31
AIR-SEA TEMP (DEG C)	-01.7	(19 00)	-00.1	02.1	(01 00)	244	31
PRESSURE (MBAR)	0998.1	(24 06)	1016.5	1031.8	(02 09)	244	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 244

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		4.9	10.7				15.6	12.3
NE		2.0	1.6				3.7	10.1
E	.4	3.3	1.6				5.3	7.9
SE		1.2					1.2	6.0
S	.4	.8	8.2	.8			10.2	14.7
SW	.4	1.6	11.5				13.5	13.8
W	1.2	7.4	13.1	.8			22.5	12.2
NW		9.4	18.4				27.9	12.3
CALM								
TOTAL	2.5	30.7	65.2	1.6			100.0	12.3

MAX WIND
SPEED: 26 KNOTS
DIRECTION: 280 DEG
DAY: 24
HOUR: 12

JULY — DATA SUMMARY — 46004

AVERAGE LATITUDE 51.0N — AVERAGE LONGITUDE 136.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	10.2	(03 18)	12.8	14.3	(31 00)	246	31
SEA TEMP (DEG C)	11.5	(01 12)	12.8	13.8	(26 00)	246	31
AIR-SEA TEMP (DEG C)	-01.9	(26 18)	-00.2	01.3	(06 18)	246	31
PRESSURE (MBAR)	0998.0	(09 15)	1017.2	1029.5	(15 00)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		4.9	1.6				6.5	9.7
NE	.4	2.0	.4				2.8	7.0
E	.4	2.4	1.2				4.1	7.7
SE	.8	4.9	3.3	1.2			10.2	11.2
S	1.2	2.0	21.1	1.6			26.0	16.0
SW	1.2	5.7	6.5	2.0			15.4	12.8
W	.8	6.1	9.8	1.2			17.9	13.1
NW		3.7	11.0	2.0			16.7	14.8
CALM	.4						.4	.0
TOTAL	5.3	31.7	54.9	8.1			100.0	13.2

MAX WIND
SPEED: 33 KNOTS
DIRECTION: 230 DEG
DAY: 20
HOUR: 09

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	2.8	67.1	26.8	2.0	1.2				1.5M	4.5M	(20 12)

AUGUST — DATA SUMMARY — 46002

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.8	(04 21)	17.8	21.2	(14 03)	247	31
SEA TEMP (DEG C)	17.5	(05 15)	19.1	21.8	(14 00)	247	31
AIR-SEA TEMP (DEG C)	-03.3	(10 00)	-01.3	00.8	(09 18)	247	31
PRESSURE (MBAR)	1003.4	(31 21)	1017.6	1028.0	(01 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	8.5	15.4				25.1	12.4
NE	1.6	8.1					9.7	5.7
E	1.2	5.3					6.5	5.2
SE	.8	3.6	2.0				6.5	8.4
S	1.6	3.2	3.2	.4			8.5	9.6
SW	.8	3.2	8.5				12.6	11.4
W		5.7	4.9				10.5	10.7
NW	.4	7.3	12.6				20.2	12.0
CALM	.4						.4	.0
TOTAL	8.1	44.9	46.6	.4			100.0	10.3

MAX WIND
SPEED: 23 KNOTS
DIRECTION: 170 DEG
DAY: 31
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	14.6	76.5	8.1	.8					1.2M	3.0M	(20 09)

AUGUST — DATA SUMMARY — 46003

AVERAGE LATITUDE 52.0N — AVERAGE LONGITUDE 156.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	10.4	(27 12)	12.3	13.7	(26 00)	248	31
SEA TEMP (DEG C)	11.9	(19 18)	12.6	14.2	(26 03)	248	31
AIR-SEA TEMP (DEG C)	-02.8	(27 12)	-00.3	01.6	(18 21)	248	31
PRESSURE (MBAR)	0992.0	(09 15)	1013.8	1026.9	(02 21)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 245

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	1.6	1.2				3.7	8.7
NE								
E		.8	.4				1.2	11.0
SE		5.3	8.2				13.5	11.8
S		4.5	15.1	1.6			21.2	14.5
SW		6.9	12.7	.8			20.4	13.2
W		11.0	19.2				30.2	12.4
NW		3.7	6.1				9.8	12.3
CALM								
TOTAL	.8	33.9	62.9	2.4			100.0	12.8

MAX WIND
SPEED: 25 KNOTS
DIRECTION: 160 DEG
DAY: 18
HOUR: 21

AUGUST — DATA SUMMARY — 46004

AVERAGE LATITUDE 51.0N — AVERAGE LONGITUDE 136.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	12.6	(03 21)	14.6	16.4	(17 00)	246	31
SEA TEMP (DEG C)	13.4	(01 12)	15.0	16.5	(13 00)	246	31
AIR-SEA TEMP (DEG C)	-01.8	(18 00)	-00.4	00.9	(23 21)	246	31
PRESSURE (MBAR)	1004.8	(31 21)	1020.2	1029.3	(02 00)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	2.4	9.8	2.0			15.0	15.8
NE	.4	.4	4.9				5.7	14.9
E		.8	2.4				3.3	13.9
SE	.4	.4	5.3				6.1	14.8
S	.8	6.1	6.9				13.8	11.0
SW		2.0	1.2				3.3	9.4
W	1.2	10.2	12.2				23.6	10.7
NW		4.9	18.3	5.7			28.9	15.3
CALM	.4						.4	.0
TOTAL	4.1	27.2	61.0	7.7			100.0	13.4

MAX WIND
SPEED: 31 KNOTS
DIRECTION: 310 DEG
DAY: 18
HOUR: 00

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	13.8	72.4	13.8						1.2M	2.5M	(18 21)

JULY — DATA SUMMARY — 46005

AVERAGE LATITUDE 46.0N — AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.6	(04 15)	14.5	17.9	(27 21)	246	31
SEA TEMP (DEG C)	12.8	(01 15)	15.0	18.0	(28 00)	246	31
AIR-SEA TEMP (DEG C)	-03.1	(28 03)	-00.5	01.1	(09 00)	246	31
PRESSURE (MBAR)	0996.8	(09 21)	1010.9	1029.1	(18 21)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.2	16.7	.8			18.7	15.3
NE	.8	.4	.4				1.6	4.3
E	.8	2.4	1.6				4.9	8.1
SE		1.2	2.0	.8			4.1	15.8
S	.4	7.3	8.5	.4			16.7	11.8
SW	.8	3.3	6.1	.4			10.6	11.5
W	.4	8.1	2.0	.8			11.4	9.6
NW	.8	8.9	20.7	1.6			32.1	13.3
CALM								
TOTAL	4.1	32.9	58.1	4.9			100.0	12.5

MAX WIND
SPEED: 32 KNOTS
DIRECTION: 300 DEG
DAY: 01
HOUR: 06

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	10.6	68.3	19.1	2.0					1.3M	3.5M (01 09)

JULY — DATA SUMMARY — 46006

AVERAGE LATITUDE 41.0N — AVERAGE LONGITUDE 138.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.2	(05 21)	16.7	20.5	(19 00)	240	31
SEA TEMP (DEG C)	16.2	(01.21)	17.8	20.2	(20 03)	239	31
AIR-SEA TEMP (DEG C)	-03.2	(05 21)	-01.2	00.5	(19 00)	239	31
PRESSURE (MBAR)	1000.5	(09 03)	1022.9	1035.0	(01 00)	240	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 240

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	3.8	14.2				18.3	13.2
NE		.8	5.4				6.3	12.7
E	.4	1.3					1.7	4.8
SE	.8	2.1					2.9	4.4
S	.4	3.8	3.8				7.9	9.9
SW	1.7	13.3	15.4	.8			31.3	11.0
W	.4	4.2	7.1	.4			12.1	13.4
NW	.4	3.3	12.9	2.9			19.6	15.7
CALM								
TOTAL	4.6	32.5	58.8	4.2			100.0	12.3

MAX WIND
SPEED: 23 KNOTS
DIRECTION: 320 DEG
DAY: 04
HOUR: 15

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 240

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	4.6	70.0	25.4						1.4M	2.5M (10 03)

JULY — DATA SUMMARY — 46009

AVERAGE LATITUDE 60.2N — AVERAGE LONGITUDE 146.8W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.2	(08 18)	13.1	19.4	(03 03)	248	31
SEA TEMP (DEG C)	10.8	(01 15)	12.8	14.8	(31 15)	248	31
AIR-SEA TEMP (DEG C)	-01.8	(07 06)	00.3	08.1	(03 03)	248	31
PRESSURE (MBAR)	1003.5	(07 06)	1015.3	1025.7	(14 21)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	11.3	6.0				18.5	9.0
NE	2.0	6.0	.8				8.8	6.0
E	2.0	4.0	9.7	1.6			17.3	12.8
SE	1.6	9.7	8.5	.4			19.1	9.3
S	2.8	13.3	1.6				17.7	8.1
SW	1.6	4.8	.4				6.9	5.4
W	2.0	3.2					5.2	4.2
NW	.8	.8	1.2				2.8	9.9
CALM	4.4						4.4	.0
TOTAL	15.5	53.2	28.2	2.0			100.0	8.0

MAX WIND
SPEED: 24 KNOTS
DIRECTION: 120 DEG
DAY: 24
HOUR: 15

AUGUST — DATA SUMMARY — 46005

AVERAGE LATITUDE 46.0N — AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	14.3	(29 06)	16.6	19.1	(09 03)	248	31
SEA TEMP (DEG C)	16.2	(03 15)	17.5	18.8	(13 00)	248	31
AIR-SEA TEMP (DEG C)	-03.4	(29 06)	-00.9	00.3	(26 12)	248	31
PRESSURE (MBAR)	1001.1	(31 21)	1018.1	1029.2	(01 21)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.4	19.0	15.7	2.0			39.1	10.8
NE	.8	3.6	4.8				9.3	11.8
E	.4	2.8	3.6	.4			7.3	11.5
SE	.8	2.4	4.4	.8			8.5	11.7
S	.8	4.4	5.2				10.5	10.1
SW	.8	1.2					2.0	5.2
W	.4	2.0	1.6	.4			4.4	10.9
NW	.8	7.7	8.9	1.6			19.0	12.0
CALM								
TOTAL	7.3	43.1	44.4	5.2			100.0	11.1

MAX WIND
SPEED: 29 KNOTS
DIRECTION: 150 DEG
DAY: 31
HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	24.7	68.8	6.1	.4					1.0M	3.0M (18 18)

AUGUST — DATA SUMMARY — 46006

AVERAGE LATITUDE 41.0N — AVERAGE LONGITUDE 138.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	16.1	(04 21)	18.9	21.3	(11 00)	248	31
SEA TEMP (DEG C)	19.2	(25 15)	19.7	21.4	(08 03)	248	31
AIR-SEA TEMP (DEG C)	-03.5	(04 21)	-00.8	01.2	(11 00)	248	31
PRESSURE (MBAR)	1003.3	(31 18)	1019.1	1030.2	(01 21)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 242

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	9.1	13.2				23.1	10.9
NE	.4	2.5	3.7				6.6	10.6
E	1.7	7.0	6.6				15.3	8.9
SE		3.3	4.5				7.9	11.3
S	.4	3.3	4.1	.8			8.7	11.5
SW	1.7	6.6	6.6	.4			15.3	10.1
W	2.1	5.4	4.5				12.0	9.0
NW	.8	5.4	4.1				10.3	8.9
CALM	.8						.8	.0
TOTAL	8.7	42.6	47.5	1.2			100.0	10.0

MAX WIND
SPEED: 24 KNOTS
DIRECTION: 210 DEG
DAY: 10
HOUR: 00

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	13.8	78.5	7.7						1.1M	2.5M (12 09)

AUGUST — DATA SUMMARY — 46009

AVERAGE LATITUDE 60.2N — AVERAGE LONGITUDE 146.8W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	09.8	(31 15)	13.3	18.2	(23 03)	247	31
SEA TEMP (DEG C)	12.1	(31 21)	13.6	16.0	(04 06)	247	31
AIR-SEA TEMP (DEG C)	-03.4	(26 12)	-00.3	05.0	(23 03)	247	31
PRESSURE (MBAR)	0998.5	(30 18)	1015.8	1024.6	(21 18)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.6	6.1	2.4				10.1	7.8
NE	1.2	3.2	.8				5.3	6.8
E	2.8	3.2	10.1	3.6			19.8	13.7
SE	1.6	10.1	12.1	1.6			25.5	11.8
S	3.2	9.3	1.6				14.2	8.7
SW	1.2	10.9	1.2				13.4	6.3
W	1.6	2.4					4.0	3.9
NW	.8	.8	.8				2.4	6.5
CALM	5.3						5.3	.0
TOTAL	10.4	46.2	28.1	5.3			100.0	9.0

MAX WIND
SPEED: 26 KNOTS
DIRECTION: 110 DEG
DAY: 10
HOUR: 18

Selected Gale and Wave Observations, North Atlantic

July and August 1979

Vessel	Call Sign	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves†: Period sec.	Sea Waves†: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.	Swell Waves: Height ft.
NORTH ATLANTIC OCEAN		JULY															
GUAYAMA	WHGO	3	41.9 N	53.9 W	06	23	35	2 NM	81	1015.0	20.0	16.7					
SHELDON LYKES	KEAY	3	12.6 N	78.0 W	12	07	35	5 NM	03	1010.2	26.7	27.8	4	6.5	07	9	18
DELAWARE GETTY	KCBE	5	35.9 N	69.0 W	06	24	35	5 NM	05	1009.0	25.0	27.2	2	8	23	< 6	6.5
T F L LIBERTY	9VDD	5	39.1 N	62.9 W	12	21	M 40	5 NM	18	1006.7	25.5	21.5	10	3	22	6	19.5
T F L INDEPENDENCE	9VVK	5	42.4 N	59.8 W	18	21	42	.5 NM	44	1000.0	19.5	17.0	5	5	24	7	11.5
GRAND FELICITY	H3NN	7	40.4 N	24.5 W	18	01	M 38	5 NM	02	1027.0	21.0						
ALEX STEPHENS	WJEN	10	26.8 N	71.0 W	00	16	35	10 NM	15	1014.0	25.0	28.8	3	6.5	16	< 6	10
EXXON BOSTON	WHML	11	26.4 N	89.7 W	00	15	35	.5 NM	64	1004.9	25.5	31.2	3	5	15	8	8
OVERSEAS ARCTIC	KLEZ	11	27.8 N	92.8 W	00	07	35	10 NM	01	1005.3	27.2	26.7	4	6.5	07	6	10
RED RIVER	KIEC	11	26.0 N	88.0 W	07	19	35	10 NM	03	1008.5	28.0	27.2	4	6.5	19	< 6	8
EXXON LEXINGTON	KIYP	11	26.4 N	87.0 W	12	17	35	10 NM	02	1010.0	29.2	31.2	4	6.5	18	7	11.5
TEXACO WISCONSIN	WIGK	11	25.6 N	86.4 W	12	18	35	10 NM	02	1009.8	29.2	30.0	5	5	18	7	8
OVERSEAS NEW YORK	WMCK	11	13.9 N	71.7 W	18	10	35	5 NM	02	1015.0	28.9	24.4	7	10	11	7	10
OVERSEAS NEW YORK	WMCK	12	14.8 N	73.2 W	00	10	35	5 NM	02	1014.0	28.3	25.0	7	10	11	7	10
LAKE ARROWHEAD	6ZYP	13	43.7 N	55.8 W	12	17	35	2 NM	81	1010.0	18.0	15.0	6	8	21	7	10
ACADIA FOREST	DSDI	13	32.2 N	58.8 W	12	20	M 36	10 NM	01	1014.0	27.0	26.0	3	5	22	8	6.5
SEALAND MARKET	KJVG	13	42.2 N	52.7 W	18	18	35	5 NM	02	1003.6	22.5	18.6	4	8	18	8	14.5
TAMPA	KKJA	21	17.6 N	74.3 W	00	10	45	5 NM	07	1011.9	30.0	31.1	10	6.5	10	< 6	16.5
JACKSONVILLE	KWAH	22	26.7 N	87.3 W	21	14	35	10 NM	16	1010.1	29.0	32.7	3	8	12	< 6	10
EXXON BOSTON	WHML	25	27.2 N	90.5 W	12	18	35	5 NM	03	1013.5	26.0	31.1	3	5	16	7	6.5
C V LIGHTNING	KAFP	29	40.7 N	64.1 W	18	20	35	10 NM	03	1013.5	25.6	22.3	4	8	20	< 6	10
EVERGREEN WAGO-295	NRXD	30	44.1 N	48.1 W	18	28	M 44	5 NM	03	1022.5	19.0	15.8	4	5			
GREAT LAKES VESSELS																	
GEORGE M HUMPHREY	WF7895	2	41.8 N	81.3 W	12	33	M 36	5 NM	25		13.0	21.0	6	6.5			
		AUG.															
EXPORT CHALLENGER	WLSG	3	30.0 N	67.8 W	12	16	55	2 NM	64	1015.2	23.8	27.7	3	5	15	< 6	14.5
DELTA MAR	KICF	3	13.4 N	74.0 W	12	10	35	10 NM	03	1011.9	27.7	25.5	6	11.5			
ADM WM M CALLAGHAN	KGYE	5	50.2 N	39.2 W	00	30	35	5 NM	50	1003.0	14.0	13.4	3	10	26	6	13
UNION PROGRESS	SMKP	5	50.1 N	32.4 W	00	25	M 40	2 NM	04	1002.0	14.0	12.0					
AMERICAN ACCORD	KFEZ	5	50.6 N	24.0 W	11	24	40	2 NM	62	0999.0	15.0	16.7	3	6.5	24	6	10
ADM WM M CALLAGHAN	KGYE	7	40.8 N	57.0 W	00	22	35	10 NM	03	1015.0	26.2	23.8	5	6.5	25	< 6	5
LAUREL	A8ZG	9	48.5 N	03.2 W	12	27	M 35	10 NM	02	1008.0	15.0	15.0	6	10	27	7	10
SILVERLINE	H3PF	10	05.8 N	27.5 W	06	19	M 36	5 NM	03	1011.3	26.5	26.5					
WESTERN SUN	KEMJ	12	35.1 N	71.5 W	18	19	35	5 NM	02	1013.2	26.5	26.7	6	3	19	10	8
PURE OIL	KQSI	12	27.9 N	80.1 W	18	32	36	5 NM	14	1017.9	25.0	29.5	2	3	28	< 6	5
HUMACAO	KGCW	13	50.0 N	16.0 W	18	32	55	.25 NM	64	0999.2	16.7	18.3			31	9	18
SEALAND MARKET	KJVG	13	40.8 N	65.0 W	18	21	50	1 NM	65	1010.3	25.6	25.0	4	10	20	8	14.5
AMERICAN ACE	KFCV	13	50.1 N	19.3 W	18	05	45	5 NM	01	1002.0	17.7	17.2	10	19.5			
AMERICAN ACE	KFCV	14	50.1 N	24.4 W	06	30	35	10 NM	25	1011.9	13.4	16.7	6	11.5	29	10	14.5
AMERICAN RANGER	KNKW	14	53.0 N	23.3 W	18	28	36	10 NM	02	1006.4	13.4	12.2	4	5	29	10	11.5
AMERICAN RANGER	KNKW	15	52.1 N	25.9 W	00	28	36	5 NM	03	1011.5	13.2	11.3	4	5	29	8	11.5
SEALAND GALLOWAY	KHLX	18	36.5 N	11.4 W	12	35	45	10 NM	03	1015.6	18.8	19.5	3	8	35	< 6	13
JAMES E O'BRIEN	GNUQ	27	43.7 N	09.6 W	18	05	M 39	10 NM	03	1013.0	18.5	17.2	4	6.5	04	< 6	10
JAMES E O'BRIEN	GNUQ	28	45.3 N	08.3 W	06	07	M 37	10 NM	03	1016.0	17.5	18.9	4	6.5	06	< 6	10
CARNIVALE	HOKL	30	18.6 N	66.2 W	06	08	35	10 NM	00	1009.2	27.8	30.6	5	6.5			
MAYAGUEZ	KAAI	30	19.4 N	65.8 W	18	09	36	5 NM	50	1008.8	27.3	27.3	3	10	09	6	11.5
TAMPA	KKJA	30	19.9 N	65.3 W	22	10	35	5 NM	02	1009.1	27.8	30.0	6	10	09	< 6	10
TAMPA	KKJA	31	19.5 N	65.8 W	06	11	35	5 NM	61	1008.8	26.7	30.0	6	10	09	6	11.5
MAYAGUEZ	KAAI	31	19.3 N	65.4 W	06	09	45	2 NM	62	1007.5	25.6	26.7	5	19.5	10	7	23
GREAT LAKES VESSELS																	
ARTHUR M ANDERSON	WE4805	7	45.3 N	83.1 W	12	19	M 35	10 NM	13		16.0	19.0	6	6.5			
MIDDLETOWN	WR3225	14	47.5 N	88.0 W	06	33	M 36	10 NM	01		11.0	15.0	5	5			
HOMER D WILLIAMS	WA5839	14	41.9 N	82.7 W	06	28	M 36	5 NM	50		21.0	20.0		5			
IRVING S OLDS	WA6108	14	47.4 N	88.7 W	06	30	M 37	10 NM	02		9.0	16.0	4	6.5			
BENJAMIN F FAIRLESS	WA2806	14	44.8 N	86.3 W	12	28	M 35	> 25 NM	01		12.0	17.0	5	5			
CLIFFS VICTORY	WD5654	14	44.3 N	82.8 W	18	30	M 40	> 25 NM	03		14.0	18.0	3	5			
HOMER D WILLIAMS	WA5839	15	44.1 N	82.6 W	00	29	M 38	10 NM	02		13.0	16.0		6.5			
LEON FALK JR	WP7987	15	44.1 N	82.6 W	06	32	M 35	10 NM	20		12.0	18.0	6	8			
A M FERBERT	WA2197	15	44.9 N	83.0 W	18	34	M 35	> 25 NM	02		15.0	16.0	3	6.5			
THOMAS W LAMONT	WB3739	31	47.3 N	89.9 W	16	32	M 45	2 NM	82		15.0	12.0	5	6.5			

† Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 km or waves ≥ 25 ft from May through August (≥ 41 km or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

Selected Gale and Wave Observations, North Pacific

July and August 1979

Vessel	Call Sign	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves† Period sec.	Sea Waves† Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		JULY															
GENEVIEVE LYKES	WZJA	1	21.3 N	145.8 W	00	07	35	10 NM	02	1020.2	23.9	23.3	8	11.5	07	8	13
SEALAND LEADER	WSNM	1	38.3 N	123.9 W	18	32	M 36	10 NM	03	1012.5	13.3	16.0	8	6.5	33	6	13
PRESIDENT JOHNSON	WVMS	2	49.3 N	127.2 W	00	28	35	10 NM	02	1010.1	14.4	12.2	3	10			
UNITED SEA ANGEL	3EEW	2	45.0 N	171.7 W	06	15	M 27	2 NM	91	1008.0	12.5	10.0	7	29.5	18	7	29.5
HONSHU GLORIA	A8PJ	2	51.3 N	169.4 W	06	18	M 40	5 NM	28	1013.5	12.0	10.0	3	10	18	< 6	13
EVER SPRING	H3WZ	2	35.2 N	142.8 E	23	20	M 38	2 NM	61	1001.5	25.0	24.0	5	16.5	22	10	19.5
PACIFIC VENTURE	HOVS	4	37.8 N	157.4 E	12	21	M 41	200 YD	65	0998.5	21.0	21.0	14	23	21	9	14.5
ORIENTAL STATESMAN	ELRE	4	37.5 N	159.1 E	18	19	M 35	5 NM	03	1001.0	21.0	14.5	7	16.5			
NORSE PILOT	GOVQ	5	31.1 N	148.3 E	00	19	M 35	5 NM	62	1001.3	25.8	22.0	5	6.5	24	6	11.5
PACIFIC VENTURE	HOVS	5	38.5 N	161.7 E	00	20	M 36	200 YD	63	1004.5	21.0	19.0	11	18	20	9	14.5
SUCCESSFUL VENTURE	SLKJ	5	29.4 N	145.7 E	00	24	M 40	5 NM	02	1003.0	26.5	26.0	4	8	23	10	16.5
ARTHUR MAERSK	OXRS	5	53.5 N	178.3 W	00	19	38	5 NM	81	1008.1	9.6	7.0	10	16.5			
SEALAND TRADE	WEUI	5	48.7 N	175.4 E	12	19	35	2 NM	10	1009.4	8.9	6.1	6	5			
SURVEYOR	WTES	7	58.2 N	151.7 W	12	31	M 35	10 NM	01	1004.6	11.0	8.3	2	5	31	< 6	5
POET	WKFP	8	35.6 N	176.2 W	00	12	35	5 NM	02	1030.1	22.8	21.3	1	5	12	< 6	11.5
PRESIDENT JEFFERSON	WPGE	8	44.8 N	161.3 E	12	10	M 35	2 NM	10	1005.5	12.2	6.7	4	5	11	7	6.5
STUYVESANT	WTHF	9	41.4 N	127.6 W	00	15	M 24	10 NM	02	1013.5	18.3	17.2	6	24.5	15	7	24.5
PRINCE WILLIAM SOUND	WSDX	9	45.2 N	128.4 W	12	12	M 36	2 NM	02	1001.6	15.0	15.6	3	8			
PHILADELPHIA	WJGO	9	51.5 N	131.1 W	12	14	35	5 NM	02	1004.4	14.4	13.3	3	8	14	< 6	6.5
SINCLAIR TEXAS	WJDC	9	42.9 N	127.4 W	18	18	35	2 NM	20	1003.0	16.1	13.3	5	8	18	8	14.5
MOBILE MERIDIAN	KGSM	9	51.1 N	130.9 W	18	13	M 37	2 NM	50	1003.0	14.4	12.2	3	6.5	13	7	11.5
PRESIDENT TRUMAN	WLRL	13	39.0 N	125.4 W	12	35	38	10 NM	02	1017.3	15.0	15.7	4	10	34	8	14.5
MAUNALEI	KSVE	14	37.2 N	124.4 W	12	36	35	10 NM	02	1013.5	14.4	16.1	4	11.5	XX		8
ARCO JUNEAU	KSBG	14	41.7 N	126.4 W	18	30	36	10 NM	02	1018.7	17.2	10.0	3	6.5	34	< 6	14.5
MANUKAI	KNLO	14	33.8 N	126.9 W	18	33	35	10 NM	01	1017.1	18.3	18.3	7	16.5	33	8	16.5
AMERICAN LEGION	WZJC	14	36.5 N	124.7 W	18	36	35	10 NM	02	1013.9	18.9	12.8	6	13	34	10	14.5
AMERICAN LEGION	WZJC	15	35.2 N	126.8 W	00	36	38	10 NM	02	1015.3	23.9	17.2	5	13	34	8	13
SEAWAY EXPRESS	DDFO	15	26.5 N	122.4 E	21	21	35	10 NM	02	1002.0	28.2	28.0		6.5	22		11.5
SEAWAY EXPRESS	DDFO	16	25.9 N	122.2 E	00	25	35	10 NM	02	1003.0	28.5	28.5	3	6.5	25	< 6	11.5
EXXON SAN FRANCISCO	KAAC	16	44.3 N	128.6 W	00	36	35	10 NM	02	1022.7	20.5	14.5	2	3	36	< 6	10
MASON LYKES	KNFN	16	20.6 N	107.8 W	03	19	40	5 NM	05	1008.5	26.1	25.0	4	6.5	19	8	16.5
ATLANTIC PIONEER	H3WN	16	45.9 N	172.0 W	12	15	M 40	2 NM		1010.0	12.0	9.0					
SEALAND PIONEER	WSVB	17	43.3 N	164.3 E	00	15	M 38	200 YD	45	1001.0	14.0	11.5	5	6.5	15	< 6	6.5
SEA FAN	9VYA	18	50.2 N	160.3 E	03	18	M 37	.5 NM	05	1000.0	10.2	4.8	6	13			
MANHATTAN	WJAF	18	34.2 N	139.8 E	06	09	48	5 NM	20	1000.2	22.2	25.0	3	8	09	8	13
POLAR ALASKA	SLEU	18	49.1 N	160.7 E	18	23	M 35	5 NM	28	1010.0	8.0	5.0	6	10			
MAYA PIONEER	JLAX	18	38.1 N	145.0 E	18	14	M 40	2 NM	25	1007.0	21.0	19.0	14	6.5	23	13	6.5
ATLANTIC PIONEER	H3WN	19	47.0 N	151.0 W	00	03	M 35	1 NM	03	1011.5	14.5	12.0	7	19.5	03	9	19.5
OJI GLORIA	SLTW	19	50.6 N	172.3 E	00	25	M 43	200 YD	45	1015.0	11.0	10.5					
ARCO ANCHORAGE	WCIO	19	34.5 N	120.6 W	00	31	M 35	1 NM	10	1009.0	12.8	12.8	2	5	32	< 6	8
JOHN LYKES	KIHO	19	42.0 N	124.8 W	00	35	35	5 NM	02	1017.0	15.0	12.8	5	3	35	8	6.5
PACIFIC WING	H3WK	19	35.9 N	142.2 E	06	09	M 35	5 NM	05	1005.0	22.5	22.0	7	19.5	36	10	8
MAYA PIONEER	JLAX	19	40.7 N	150.0 E	06	09	M 44	2 NM	18	1017.0	18.2	15.0	14	6.5	23	>13	6.5
SPRUCE	JPOP	19	50.7 N	178.2 E	18	20	M 40	2 NM	03	1015.0	8.9	11.0	5	6.5	02	< 6	6.5
PACIFIC VENTURE	HOVS	19	45.4 N	144.6 W	18	26	M 35	5 NM	18	1020.0	14.0	13.0	9	18	26	9	18
VELMA LYKES	KVMU	19	35.3 N	159.8 W	18	06	40	10 NM	15	1022.3	18.9	18.3	5	13	05	6	13
VAN WARRIOR	SMEV	19	52.2 N	175.3 E	18	24	40	1 NM	61	1009.0	10.0	9.0					
OJI GLORIA	SLTW	20	50.0 N	166.5 E	00	25	M 42	200 YD	45	1018.0	8.5	9.0					
SANSINENA II	WSIN	20	40.8 N	125.1 W	00	01	35	5 NM	02	1011.5	15.5	11.6			02	8	16.5
ARCO ANCHORAGE	WCIO	20	39.6 N	125.0 W	00	33	M 38	2 NM	07	1008.1	15.0	11.2	3	8	33	6	10
PRESIDENT TRUMAN	WLRL	20	46.2 N	170.4 E	06	28	35	5 NM	02	1024.4	8.3	8.3	2	6.5	25	6	6.5
VAN WARRIOR	SMEV	20	51.2 N	171.9 E	06	27	40	2 NM	50	1010.0	12.0	7.0					
MAYA PIONEER	JLAX	20	43.6 N	157.3 E	12	11	M 35	.25 NM	62	1016.2	13.0	12.0	14	6.5	11	>13	6.5
SPRUCE	JPOP	20	48.6 N	171.2 E	18	26	M 40	.5 NM	12	1016.0	7.0	9.5	9	10	08	9	10
SEALAND COMMERCE	WEUJ	21	39.1 N	128.5 W	18	01	35	10 NM	02	1021.3	16.7	13.3			01	12	19.5
FRIENDSHIP	ELXP	22	40.3 N	166.6 E	00	24	M 40	2 NM	60	1014.7	21.0	21.0	7	6.5	25	< 6	8
TRANSONEIDA	KSKE	22	38.6 N	129.3 W	12	01	35	10 NM	02	1022.4	16.1	17.2	7	13			
FRIENDSHIP	ELXP	24	38.2 N	148.0 E	00	28	M 38	1 NM	46	1010.0	21.0	21.0	6	6.5	25	6	8
CRESSIDA	3FTB	24	53.6 N	149.5 W	12	17	M 36	5 NM	05	1010.5	13.5	8.9	6	16.5	17	6	23
TOWNSEND CROMWELL	WTDF	24	23.8 N	166.2 W	18	09	M 35	10 NM	03	1019.1	24.5		2	5	08	6	8
CRESSIDA	3FTB	25	53.9 N	153.7 W	00	25	M 28	5 NM	05	1014.5	10.0	9.0	9	26	25	9	29.5
SINCLAIR TEXAS	WJDC	25	40.4 N	125.7 W	00	34	35	10 NM	02	1016.0	15.6	13.9	6	5	35	9	11.5
NEW GOLDEN PHOENIX	3EYN	27	51.3 N	165.6 W	06	30	M 38	5 NM	02	1007.0	11.0	11.0	6	6.5	25	6	6.5
AMERICAN TRADER	WEZM	27	25.0 N	120.7 E	12	04	35	10 NM	02	1007.0	28.9	26.6	3	8	03	< 6	10
ASIA HONESTY	A8LL	27	24.6 N	120.6 E	12	03	M 37	5 NM	02	1001.0	32.0	31.0	XX	6.5	03	8	8
MOON RIVER	SLBN	27	51.7 N	167.0 E	18	22	M 35	< 50 YD	03	1012.5	9.0	9.0	2	8	22	6	8
AMERICAN LEGION	WZJC	29	16.8 N	133.5 E	00	29	40	2 NM	81	1002.7	25.0	28.3	4	10	32	8	10
SEALAND FINANCE	WJKG	29	41.8 N	153.0 E	06	16	40	.5 NM	46	1005.5	17.2	14.4	4	10	16	6	8
		AUG.															
TOYOTA MARU 10	JKBI	1	39.3 N	126.2 W	18	33	M 36	10 NM	02	1022.0	18.5	15.0	4	3	35	6	11.5
CHEVRON ARIZONA	KGBE	3	39.7 N	124.9 W	06	34	M 38	10 NM	03	1012.2	14.0		3	6.5	34	6	13
MOBIL ARCTIC	KSPY	3	40.0 N	125.5 W	12	34	40	10 NM	02	1013.2	15.0	11.1	4	5	35	8	10
PRESIDENT TYLER	WEZM	3	39.6 N	126.9 W	18	36	M 38	10 NM	02	1016.6	16.5	11.7	5	8	36	7	10
SEATRAIN LEXINGTON	DHFC	3	38.5 N	127.0 W	18	36	37	5 NM	18	1017.0	17.0	18.0	4	10	36	6	8
AUSTRAL MOON	WEZT	4	03.9 N	160.4 W	12	08	M 15	10 NM	03	1006.8	26.5	26.7	4	6.5	07	7	24.5
MOON RIVER	SLBN	6	45.3 N	159.1 E	00	12	M 36	2 NM	10	1010.0	13.5	13.0	5	13	12	8	6.5
BREWSTER	H3NF	7	54.3 N	166.0 W	00	26	M 35	2 NM	10	1016.4	9.0	9.5	5	5	26	9	10
BREWSTER	H3NF	8	52.3 N	177.8 W	12	24	M 40	1 NM	12	0994.4	8.0	9.0	3	3	24	7	5
SINCERE NO 3	ELRT	8	52.6 N	179.9 W	12	35	M 39	200 YD	55	0999.9	8.5	8.0					
PRESIDENT TYLER	WEZM	8	48.0 N	172.1 W	12	22	M 36	200 YD	45	1007.5	12.2	9.4	4	8	26	7	11.5
ALVA MAERSK	OZSD	8	50.6 N	167.3 W	18	27	35	2 NM	62	0999.5	11.5	9.0		13			
FRANCIS SINCERE NO 6	SMCN	8	49.9 N	169.6 W	18	26	M 37	2 NM	10	0998.5	10.5	11.0	5	13	24	< 6	6.5
SEALAND TRADE	WEUI	9	47.7 N	179.7 E	00	29	35	2 NM	01	1016.3	11.7	8.9	5	5	29	8	11.5
ZIM TOKYO	DDRF	9	46.8 N	174.2 W	00	28	37	2 NM	20	1012.0	13.1	11.1	10	11.5	28	10	10
ALVA MAERSK	OZSD	9	50.7 N	173.6 W	06	32	40	5 NM	01	1005.0	12.0		8	16.5	27		16.5
TAUBE	9VUL	9	50.3 N	172.7 W	06	33	M 46	1 NM	41	1005.0	11.0	11.0	7	11.5	31	9	16.5
NEW GOLDEN PHOENIX	3EYN	9	48.5 N	167.2 W	12	29	M 45	5 NM	02	1000.5	12.0	11.0	8	13	29	8	13
GOLDEN GATE BRIDGE	JPZD	9	47.0 N	162.0 W	12	25	M 36	2 NM	02	1003.0	12.5	13.0	5	10	26	10	16.5
NEW GOLDEN PHOENIX	3EYN	10	48.6 N	170.1 W	00	29	M 35	5 NM	01	1016.0	11.0	12.0	7	11.5	25	7	11.5
PRESIDENT PIERCE	WUBV	10	54.3 N	165.8 W	00	32	35	2 NM	10	1001.0	11.7	10.6	3	8	35	< 6	8
BREWSTER	H3NF	10	49.4 N	167.2 E	12	23	M 35	1 NM	10	0999.3	10.5	9.5	5	5	23	8	10
FRIENDSHIP	ELXP	11	35.7 N	123.7 W	18	32	M 35	10 NM	00	1015.3	17.0	16.0	4	3	32	< 6	6.5
SURVEYOR	WTES	12	56.1 N	162.2 W	00	15	M 35	10 NM	01	1002.4	12.2	11.1	5	6.5	00		8

Vessel	Call Sign	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves+: Period sec.	Sea Waves+: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.	Swell Waves: Height ft.
NORTH PACIFIC OCEAN		AUG.															
SEATRAIN LEXINGTON	DHFC	13	32.3 N	145.7 E	00	20	37	1 NM	65	1000.0	24.0	26.3	4	10			
CHARLES LYKES	KLHR	13	25.8 N	126.3 E	12	09	35	10 NM	15	0996.2	30.5	26.7	7	10	10	7	13
CORVIGLIA	HBDE	13	15.7 N	133.1 E	18	20	39	5 NM	03	1007.0	28.7	30.0	6	11.5	29	11	16.5
CHARLES LYKES	KLHR	14	25.3 N	121.4 E	00	36	35	5 NM	15	0996.5	28.8	24.5	6	10	36	7	11.5
PRESIDENT KENNEDY	KCAK	14	24.7 N	128.4 E	06	14	40	5 NM	02	0999.3	28.9	27.8	8	16.5	14	8	29.5
AMERICAN APOLLO	KEOD	14	26.1 N	123.1 E	12	03	40	2 NM	81	0985.9	27.2	25.0	3	8	03	< 6	14.5
CORVIGLIA	HBDE	14	19.7 N	131.2 E	18	20	38	2 NM	81	1004.3	26.0	29.0	6	18			
CAPRICORN	KHLN	14	26.3 N	128.3 E	21	19	M 50	5 NM	02	0991.5	29.0	29.4	2	8	18	6	16.5
HARDANGER	LFFG	15	22.5 N	124.8 E	00	20	40	2 NM	60	0990.0	28.2		7	13	25	10	23
PRESIDENT KENNEDY	KCAK	15	22.8 N	126.3 E	00	19	45	2 NM	62	0992.0	27.8	27.8	4	13	XX		32.5
EVER SPRING	H3WZ	15	33.6 N	145.6 E	05	14	M 48	2 NM	52	1001.0	26.0	27.0	4	16.5	17	10	19.5
CORVIGLIA	HBDE	15	21.1 N	130.0 E	06	20	38	5 NM	02	1003.2	30.0	29.0	6	18			
SEATRAIN PRINCETON	DHPV	15	22.4 N	125.2 E	06	18	38	5 NM	15	0995.0	28.1	28.0	5	23	19	7	26
CAPRICORN	KHLN	15	25.8 N	128.1 E	09	18	M 50	1 NM	02	0998.1	29.0	28.9	4	11.5	18	6	10
ALVA MAERSK	OZSD	15	27.5 N	122.4 E	09	01	60	.5 NM	81	0974.2	27.0	29.0	14	37.5			
SEALAND TRADE	WEUI	15	28.3 N	130.3 E	15	18	45	5 NM	02	1000.5	27.8	28.3	5	6.5	18	9	19.5
SEATRAIN LEXINGTON	DHFC	15	25.4 N	129.4 E	15	20	37	5 NM	02	1001.5	28.6	28.5			20	9	32.5
AMERICAN APOLLO	KEOD	15	23.4 N	123.5 E	18	18	35	5 NM	02	0994.8	28.3	27.8	3	6.5	18	< 6	11.5
SEATRAIN LEXINGTON	DHFC	16	24.9 N	128.1 E	00	20	30	5 NM	02	1001.5	28.3	28.5			20	9	28
SEALAND TRADE	WEUI	16	25.0 N	126.7 E	03	19	40	5 NM	02	0997.1	27.7	26.7	5	6.5	19	11	21
ARCO FAIRBANKS	WGWB	16	58.7 N	143.7 W	18	14	M 40	2 NM	02	1000.3	13.4	12.3	6	8	12	6	8
EXXON NEW ORLEANS	WNDM	16	58.9 N	144.3 W	18	12	M 40	2 NM	63	1001.8	14.3	14.3	XX	8	16	7	16.5
SEALAND COMMERCE	WEUJ	17	50.8 N	138.7 W	06	19	35	.25 NM	64	1007.2	15.0	12.3	9	8	17	12	16.5
ENNA G	C2DG	17	10.7 N	149.4 E	21	25	40	2 NM	51	1012.7	25.3	30.5	9	14.5	27	< 6	14.5
SEALAND MCLEAN	WHGA	18	37.4 N	147.0 E	06	20	35	5 NM	03	1001.0	24.4	23.9	3	6.5	18	6	10
FRIENDSHIP	ELXP	19	42.4 N	172.4 E	00	25	M 38	2 NM	60	1006.5	19.5	18.0	4	5	25	< 6	6.5
SUNNY OCEAN	JRRG	19	44.3 N	179.9 W	06	31	M 39	1 NM	47	0999.0	13.5	14.0	9	13	32	9	14.5
AMERICAN LANCER	WZJB	19	15.8 N	135.6 E	06	24	45	5 NM	18	1000.0	27.8	27.8	6	16.5	24	< 6	16.5
LIPSCOMB LYKES	WLDL	19	41.0 N	173.2 W	18	30	35	10 NM	01	0999.0	17.3	17.8	4	6.5	29	< 6	14.5
LIPSCOMB LYKES	WLDL	20	41.0 N	176.0 W	00	31	38	10 NM	02	1003.0	15.4	17.8	4	10	30	< 6	14.5
AMERICAN LANCER	WZJB	20	18.0 N	129.1 E	01	28	40	5 NM	18	1003.0	25.6	27.8	6	13			
SPRUCE	JPQP	21	48.5 N	166.8 W	12	09	M 45	1 NM	02	1005.5	12.5	11.0	10	14.5	27	10	14.5
SEALAND TRADE	WEUI	22	29.3 N	128.0 E	00	09	35	10 NM	01	1000.1	27.2	26.7	5	5	09	9	11.5
SEALAND MCLEAN	WHGA	22	51.7 N	158.9 W	06	13	35	200 YD	45	1021.0	14.0	10.0	5	8	21	8	13
PRESIDENT HOOVER	WTST	22	46.3 N	159.9 W	06	13	40	.25 NM	62	1008.0	16.2	13.7	3	6.5	13	< 6	19.5
JAPAN ACE	JKFS	22	44.3 N	159.0 W	06	14	M 35	1 NM	53	1013.5	19.0	16.0	3	5	12	8	10
HOWELL LYKES	WLBP	22	27.9 N	123.7 E	11	06	40	5 NM	03	1007.0	28.3	27.8	2	10	05	6	13
SPRUCE	JPQP	22	48.9 N	160.1 W	12	14	M 45	1 NM	02	1009.0	13.8	12.0	10	24.5	32	10	24.5
PRESIDENT VAN BUREN	WWPI	22	21.7 N	124.4 E	18	28	45	2 NM	03	0999.4	31.1	27.2		11.5	XX		23
PRESIDENT VAN BUREN	WWPI	23	21.5 N	126.7 E	00	25	45	2 NM	95	0998.0	26.7	27.2	10	10	26	10	23
SEATRAIN LEXINGTON	DHFC	23	22.1 N	125.7 E	00	24	35	2 NM	81	0996.5	27.3	28.2	6	23	XX	7	26
GENISTA	ABCY	23	23.3 N	128.3 E	06	18	M 41	.25 NM	60	1002.0	26.0	25.0	5	8	18	7	23
BRINTON LYKES	WLAO	23	27.0 N	122.0 E	06	35	40	5 NM	52	0999.0	26.1	27.8	5	11.5	03	8	13
OCEAN LOG	8JLF	24	48.0 N	162.0 E	00	23	M 35	200 YD	40	0996.5	11.0	9.0	6	5	23	8	8
ASIA BOTAN	ELRY	24	48.5 N	166.5 E	00	23	M 37	1 NM	40	0999.0	12.0	14.0	4	6.5	04	7	11.5
SPRUCE	JPQP	25	48.3 N	137.7 W	06	07	M 35	5 NM	03	1011.5	16.0	16.0	4	6.5	23	8	8
PRESIDENT POLK	WNEI	25	32.1 N	128.7 E	12	16	40	5 NM	51	1002.0	26.7	26.7			21	13	16.5
PRESIDENT POLK	WNEI	26	28.7 N	128.2 E	00	19	45	5 NM	02	1005.0	28.4	26.7	3	8	21	6	16.5
OCEAN LOG	8JLF	27	37.4 N	143.7 E	06	23	M 43	5 NM	07	1003.5	28.0	25.0	7	11.5	23	8	13
ASIA BOTAN	ELRY	27	38.6 N	146.5 E	12	18	M 40	5 NM	05	1003.5	25.0	28.0	4	10	18	7	10
ASIA BRAVERY	ABCM	27	37.5 N	143.5 E	16	20	M 37	2 NM	02	1001.5	27.0	26.0					
PRESIDENT MADISON	WCIP	27	41.0 N	147.7 E	18	20	35	5 NM	02	1000.5	22.7	16.7	3	8	20	6	14.5
PRESIDENT MADISON	WCIP	28	39.7 N	146.1 E	00	20	35	2 NM	02	1001.6	26.1	23.3	5	8	20	7	16.5
PAN PACIFIC	D7SD	29	50.6 N	168.8 E	00	21	38	.5 NM	61	1008.0	11.0	9.0	4	10	22	8	16.5
MAYA PIONEER	JLAX	29	53.1 N	172.4 E	06	19	M 45	.5 NM	12	1007.5	11.0	12.0					
PRESIDENT KENNEDY	KCAK	29	44.9 N	158.8 W	12	06	42	2 NM	02	1010.0	15.0	13.9	5	8	07	7	13
ATLANTIC PIONEER	H3WN	29	45.3 N	160.7 W	12	04	M 35	10 NM	03	1013.7	14.5	14.0					
NEW GOLDEN PHOENIX	3EYN	30	33.5 N	139.4 E	00	05	M 38	5 NM	25	1011.5	25.0	27.5	8	13	06	8	13
MAYA PIONEER	JLAX	30	49.6 N	163.3 E	12	23	M 45	1 NM	12	1013.5	11.0	11.0	7	8	25	11	8
TOYOTA NO 24	5MTS	31	51.6 N	173.2 E	03	25	M 35	2 NM	50	1011.0	10.0	10.0	7	8	25	7	8
SUNWARD	ELZT	31	36.5 N	146.7 E	12	07	37	5 NM	02	1016.0	24.0	22.0	6	11.5	06	8	16.5

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

U.S. Cooperative Ship Weather Reports

July and August 1979

This listing includes only those ships recruited in the U.S. Cooperative Ship Program whose Ship's Weather Observations (NOAA Form 72-1) were mailed to the National Climatic Center and/or the coded weather observations were transmitted to the appropriate radio station.

SHIP NAME	VIA RADIO	VIA MAIL
OGDEN THAMES	86	39
ADABELLE LYKES	23	66
AFRICAN DAWN		46
AGUADILLA	63	130
ALASKA STANDARD	29	55
ALERT	11	
ALLISON LYKES	11	
ALVA MAERSK	31	84
AMERICAN ACCORD	32	113
AMERICAN AQUARIUS	41	109
AMERICAN ASTRONAUT	46	142
AMERICAN CHIEFTAIN	2	50
AMERICAN LANCER	44	123
AMERICAN LEGEND	49	108
AMERICAN RACER	15	72
AMERICANA	1	
AMOCO SINGAPORE	1	
ANDERS MAERSK	26	83
ANTONIA JOHNSON	6	14
ARCO COMPETITOR	4	
ARCO JUNEAU	77	105
ARCTIC TOKYO	1	108
ARTHUR MAERSK	21	85
ASIA BEAUTY	40	75
ASIA MERON	19	18
ASIA LOYALTY	6	
ATLANTIC JAMACIAN	1	
AUSTRAL ENSIGN	48	107
AUSTRAL MOON	50	109
AVILA	25	106
BALD BUTTE		117
BARTLETT AGOR 13	45	
BEISHU MARU	100	40
BERNES	18	
BOHEME	42	76
BOUTWELL WHEC 719	112	127
BRINTON LYKES	35	89
C V STAGHOUND	25	46
CALIFORNIAN	44	63
CAPTAIN COOK	1	
CARNIVALE	51	79
CHANCELLORSVILLE	30	112
CHARLOTTE LYKES	30	88
CHEROKEE WHEC 165		31
CHEVRON ARIZONA	48	82
CHEVRON COPENHAGEN		77
CHEVRON HAWAII	53	21
CHEVRON MISSISSIPPI	38	44
CHEVRON PERNIS	66	219
CHI CHING	10	
CITY OF HEREFORD	1	
COLUMBIA	16	28
COLUMBUS LOUISANA	62	127
COMANCHE WMEC 202	9	5
CORAL ACE	16	
CORONADO	49	134
COVADONGA	6	103
CUMBERLANDIA	71	
DAVID D. IRWIN	24	43
DAVIDSON	16	
DEL SOL	15	
DELTA AFRICA		37
DELTA MAR	14	77
DELTA SUD		49
DISCOVERER OSS	120	154
DON CARLOS	14	26
DRAGAMINAS	30	
DYVI PACIFIC	6	
EASTERN JADE	23	
EASTERN WISEMAN	18	
EL MEXICANO		58
EL PASO SOUTHERN	11	25
ERNA OLDENDORFF	1	
ESSO CHITTAGONG	1	
EURO-ASIA CONCORDE	24	81
EVER SUMMIT	9	111
EXPORT AIDE	8	29
EXPORT BUYER	16	48
EXPORT COURIER	12	
EXXON BALTIMORE	37	77
EXXON FLORENCE	22	25
EXXON JAMESTOWN	50	75
EXXON PHILADELPHIA	6	9
FAIRWIND	1	
FLEETBANK	35	
FRANCIS SINCEPE NO 6	34	49
GALLEON JADE	20	
GARTHNEWYDD	7	9
GENEVIEVE LYKES	43	43
GEORGE WALTON	16	38
GLOBAL FRONTIER	22	75
GOLDEN DAISY	19	56
GOLDEN GATE BRIDGE	110	82
GOLDEN ROD	5	
GRAND GLOBE	12	14
GREEN AUKLET	32	
GREEN VALLEY		69
GULF BANKER	18	17
GULF TRADER	8	77
GUNGA BROVIG	2	
HAMILTON WHEC 715		53
HAWAIIAN CITIZEN	47	64
HESS VOYAGER	38	67
HOEGH MARLIN	2	40
HOEGH OPAL	26	
HONSHU GLORIA	62	176
HUDSON T-AG 184	18	
INGER	14	85
ITAPUCA	6	
J T HIGGINS		169
JALAYAMINI	25	
JAPAN ACE	101	52
JAPAN CAOBO	5	47
JELA TOPIC	13	
JOHN LYKES	42	122
JOSEPH LYKES	3	79
KEIYO	17	83
KOPAA	130	182
KOREAN PRIDE	22	32
LAKE ARROWHEAD	18	113
LAKE TAHOE	41	215
LAUREL	50	126
LETITIA LYKES	15	55
ACADIA FOREST	47	117
ADM WM M CALLAGHAN	38	138
AFRICAN MERCURY	6	21
AHRENSBURG	1	
ALASKAN	13	25
ALEUTIAN DEVELOPER	11	22
ALLTRANS EXPRESS	52	92
AMELIA TOPIC	7	
AMERICAN ACE	22	84
AMERICAN ARCHER	7	114
AMERICAN CHALLENGER	1	82
AMERICAN CORSAIR	13	20
AMERICAN LARK	56	145
AMERICAN LEGION	22	127
AMERICAN RANGER	37	98
AMOCO BALTIMORE	3	
ANCHORAGE	17	74
ANNA MAERSK	46	106
AQUILA	19	17
ARCO ENTERPRISE	9	
ARCO PRESTIGE	46	87
ARECIBO	72	152
ARTHUR MIDDLETON	4	38
ASIA BOTAN	19	80
A.IA HONESTY	21	71
ASIA ZEBRA	14	35
ATLANTIC PIONEER	19	125
AUSTRAL ENTENTE	48	107
AUSTRAL PATRIOT	16	74
AXEL MAERSK	51	62
BALTIMORE TRADER	35	76
BARNA	23	58
BELLADONA VENTURE	8	
BIBB WHEC 31		35
BONITA	9	
BRAZOS	85	161
BUNGA SRIPAGI	28	
C.W. KITTO		163
CAMARA	1	
CAPRIDE SEADRIFT	16	120
CEDRELA	39	39
CHARLES LYKES	53	125
CHASTINE MAERSK	17	
CHERRY VALLEY	12	78
CHEVRON BURNABY	22	109
CHEVRON EDINBURGH	1	95
CHEVRON KENTUCKY	118	
CHEVRON NAGASAKI		105
CHEVRON PERTH	21	166
CHRISTOPHER LYKES	25	73
CIUDAD DE GUAYAQUIL	5	
COLUMBIA RIVER L/V	422	480
COLUMBUS NEW ZEALAND	14	85
COMET	28	58
CORAL ARCADIA	21	
CORVIGLIA	25	32
CRESSIDA	30	103
DAIOH MARU	10	91
DAVID P REYNOLDS	74	156
DEFIANCE	6	92
DELAWARE GETTY	63	97
DELTA ARGENTINA	9	51
DELTA MEXICO	26	28
DELTA URUGUAY	3	24
DITTE SKOU	7	147
DON JUAN	17	25
DRUCILLA U	47	
EAGLE	49	
EASTERN MUSE	47	
EASTERN WORLD	18	
EL PASO ARZEW	103	141
ELIZABETH LYKES	23	119
ESSO BAHAMAS	1	
ESSO PALM BEACH	15	
EVELINE	8	
EVERGREEN WAGO-295	76	83
EXPORT BANNER	31	126
EXPORT CHALLENGER	19	89
EXPORT FREEDOM	21	36
EXXON BANGOR	31	74
EXXON GETTYSBURG	31	21
EXXON LEXINGTON	25	55
EXXON SAN FRANCISCO	17	37
FALSTRIA	46	59
FORT FETTERMAN	1	
FREDERICK LYKES	9	
GALLEON PEARL	3	
GEMINI	14	52
GENISTA	19	21
GEORGIANA	17	
GLOMAR CHALLENGER	72	95
GOLDEN DOLPHIN		15
GOLDEN LIGHT	1	
GRACE	4	
GREAT LAND	53	11
GREEN FOREST	1	
GREEN WAVE	13	
GULF BEAR	24	36
GULFDEER	1	
GUNDULIC	2	
HARDANGER	22	33
HELIOS	13	32
HIEI MARU	89	63
HOEGH MASCOT	13	
HOEGH ORRIS	9	52
HOTAKA MARU	127	71
HUMACAO	22	29
IRIS ISLAND	31	53
J E GOSLINE	43	88
JACKSONVILLE	21	57
JALAVAMUNA	2	
JAPAN AMBASSADOR	8	14
JAPAN RAINBOW	9	42
JILL CORD	1	
JOHN PENN	6	
JUTHLANDIA	38	51
KEYSTONER	39	
KOREAN COMMANDER	13	
KRPAN	13	
LAKE BERRYESSA	18	28
LASH ATLANTICO	20	59
LEDA MAERSK	11	
LEXA MAERSK	95	
ACONCAGUA	16	7
ADRIAN MAERSK	35	124
AFRICAN METEOR	10	46
AIDA	1	
ALBATROSS IV	42	
ALEX STEPHENS	11	37
ALMERIA LYKES	19	67
AMERICA MARU	114	53
AMERICAN ALLIANCE	32	116
AMERICAN ARGOSY	32	102
AMERICAN CHAMPION	34	79
AMERICAN EXPLORER	8	
AMERICAN LEADER	21	71
AMERICAN LIBERTY	25	130
AMERICAN RELIANCE	9	61
AMOCO CAIRO		142
ANCO STANE	56	
ANNIE JOHNSON	12	55
ARAS	4	
ARCO FAIRBANKS	81	109
ARCO PRUDHOE BAY	41	75
ARILD MAERSK	28	72
ARYA MAN	1	
ASIA BRAVERY	31	146
ASIA HUNTER	11	
ASIAN ASSURANCE		69
AUSTIN	1	
AUSTRAL ENVOY	25	79
AUSTRAL PILOT	12	
B T SAN DIEGO	31	125
BARBER TOBA	9	
BAYAMON	18	38
BELLMAN	57	
BLUE OCEAN	20	137
BORINQUEN	14	17
BREWSTER	39	184
BUTTONWOOD WLB 306	33	
CADOGAN	1	
CAMPBELL WHEC 32	1	58
CARIBIA	46	
CHALLENGER		97
CHARLES PIGOTT		133
CHAVEZ	47	109
CHESNUT HILL	3	7
CHEVRON CALIFORNIA	81	124
CHEVRON FELUY	1	195
CHEVRON LONDON		176
CHEVRON NORTH AMERICA		49
CHEVRON SOUTH AMERICA		16
CHUEN ON	4	
CLARA MAERSK	5	
COLUMBUS AMERICA	33	
COLUMBUS VICTORIA	55	115
CONALCO	52	99
CORANTIJN	30	67
COSMOS GIENAH	22	
CRISTOBAL	23	106
DANWOOD ICE	28	43
DAVID PACKARD	5	68
DEL ORO	8	29
DELAWARE II	107	129
DELTA BRASIL	8	8
DELTA PARAGUAY	6	28
DELTA VENEZUELA	11	29
DOCTOR LYKES	53	147
DONA CORAZON II		99
DUBHE	8	
EASTERN BRIDE	6	
EASTERN PACIFIC	44	69
EDELWEISS	4	
EL PASO HOWARD BOYD	10	69
EMPIRE STATE	33	7
ESSO BAYONNE	11	
ESSO PROVIDENCE	96	116
EVELYN MAERSK	1	
EXPORT ADVENTURER	5	
EXPORT BAY	8	20
EXPORT CHAMPION	11	29
EXPORT LEADER	4	62
EXXON BATON ROUGE	43	60
EXXON HOUSTON	15	25
EXXON NEW ORLEANS	27	34
EXXON WASHINGTON	12	19
FEDTRADE	2	
FORT HOSKINS	8	91
FRIENDSHIP	15	126
GANDHIRA	2	
GEMINI TRADER		2
GEORGE B KELEZ	11	
GIBRALTAR MARU	26	44
GOLDEN ARROW	93	56
GOLDEN EXPLORER	15	20
GOLDEN ORCHID	1	
GRAND CARRIER	22	59
GREAT OCEAN	19	94
GREEN HARBOUR	40	78
GUADALUPE	55	
GULF FARMER	10	73
GULFQUEEN	1	
GUNTHER SCHULTE	1	
HARMOJIN	15	
HELLESPONT GLORY	2	188
HILLYER BROWN	12	15
HOEGH MERCHANT	12	23
HONSING ARROW	1	11
HOUSTON	47	118
IPA	1	
IRIS QUEEN	110	
J LOUIS	59	122
JADRAN	40	
JAMES E O'BRIEN	1	85
JAPAN AMBROSE	60	36
JEAN LYKES	1	7
JOHN A. MCCONE		96
JOHN TYLER	10	42
K H CRANDALL	21	163
KINGDOM VENTURE	24	
KOREAN FIR	8	9
KUROBE MARU	22	26
LAKE PALOURDE	8	173
LASH ITALIA	7	20
LEO	24	31
LIONS GATE BRIDGE	99	43
ACUSHNET WAGO 167		76
AFRICAN COMET	5	22
AFRICAN SUN	6	
AIMEE LYKES	13	61
ALBERT MAERSK	18	84
ALLEGIANCE	2	
ALSTER EXPRESS	109	59
AMERICA SUN	31	129
AMERICAN APOLLO	19	137
AMERICAN ARROW	11	
AMERICAN CHARGER	7	89
AMERICAN INDEPENDENCE	14	117
AMERICAN LEGACY	33	33
AMERICAN LYNX	16	152
AMERICAN TRADER	49	313
AMOCO MILFORD HAVEN	59	93
ANCO TEMPLAR	35	
ANTE TOPIC		64
ARCO ANCHORAGE	66	119
ARCO HERITAGE	2	20
ARCO SAG RIVER	72	128
ARNOLD MAERSK	46	78
ASHLEY LYKES	27	104
ASIA FLAMINGO	1	
ASIA INDUSTRY	20	
ATLANTIC ENDEAVOR	1	
AUSTRAL ENDURANCE	31	
AUSTRAL LIGHTNING	63	182
AUSTRAL RAINBOW	55	113
BARNES	7	
BARRANCA	54	
BAYANO	23	41
BERGLJOT	1	
BLUEBIRD	69	33
BOSTON	17	49
BRIGHT HOPE	18	
C V LIGHTNING	16	61
CALIFORNIA RAINBOW	11	18
CAPRICORN	38	109
CARMEN A	5	10
CHALMETTE	108	93
CHARLESTON	24	113
CHERISH	18	9
CHEVRON ANTWERP	21	149
CHEVRON COLORADO	41	33
CHEVRON FRANKFURT	3	
CHEVRON LOUISIANA	7	
CHEVRON OREGON	7	
CHEVRON WASHINGTON	50	98
CITY OF DUNDEE	3	
COLORADO	48	156
COLUMBUS AUSTRALIA	5	52
COLUMBUS WELLINGTON	34	99
CONFIDENCE WMEC 619	1	
CORNUCOPIA	36	81
COURAGEOUS WMEC 622		83
CRYSTAL REED	18	
DAUNTLESS CG	3	45
DAVID STARR JORDAN	12	28
DEL RIO	18	78
DELAWARE SUN	23	92
DELTA ECUADOR	12	13
DELTA PERU	2	38
DIANA PROSPERITY	20	
DOLLY TURMAN	17	75
DORIC	15	78
DYVI KATTEGAT	6	
EASTERN FORTUNE	4	17
EASTERN TREASURE	7	1
EDGAR M QUEENY	15	2
EL PASO SONATRACH	12	50
EMMA G	65	158
ESSO CASTELLON	4	
EUGENIO C.	4	
EVER SPRING	34	82
EXPORT AGENT	7	27
EXPORT BUILDER	23	137
EXPORT COMMERCE		50
EXPORT PATRIOT	9	69
EXXON BOSTON	47	86
EXXON HUNTINGTON	27	65
EXXON NEWARK	11	21
FAIRLOAD	1	
FESTIVALE	55	64
FRANCE MARU	47	46
GALLEON CORAL	6	
GARDENIA	5	88
GENE TREFETHEN	81	
GEORGE M KELLER	13	202
GLACIER BAY	27	108
GOLDEN BEAR	47	122
GOLDEN GATE	45	63
GOLDEN RAY	4	26
GRAND FELICITY	1	11
GREAT REPUBLIC	32	99
GREEN ISLAND	12	42
GUAYAMA	23	81
GULF MERCHANT	5	11
GULFSOLAR	2	
GUTENFELS	3	
HARUNA MARU	120	48
HERON	43	72
HOEGH MALLARD	15	
HOEGH MERIT	21	82
HOLY QUEEN	1	
HOWELL LYKES	38	118
INACHUS STAR	36	108
IRONWOOD WLB 297	57	
J R GREY	6	189
JAG DARSHAN	20	
JAMES LYKES	15	7
JAPAN BEAR	23	56
JEFF DAVIS	6	28
JOHN B WATERMAN	4	6
JOSEPH HEWES	29	45
KASHU MARU	34	7
KOFUKU MARU	23	120
KOREAN JUPITER	3	18
L.W. FUNKHOUSER	12	184
LAKE SHASTA	2	1
LASH PACIFICO	24	43
LESLIE LYKES	43	63
LIPSCOMB LYKES	51	100

TOTAL WEATHER REPORTS RECEIVED FROM US COOPERATIVE OBSERVING SHIPS JULY AND AUGUST 1979

SHIP NAME	VIA RADIO	VIA MAIL	SHIP NAME	VIA RADIO	VIA MAIL	SHIP NAME	VIA RADIO	VIA MAIL	SHIP NAME	VIA RADIO	VIA MAIL
LONG BEACH	2		LOTUS	1		LOUISE	88	151	LOUISE LYKES	25	57
LUIGI GRIMALDI	53	46	LURLINE	110	177	LYNCH T-AGOR 7	4	11	MAGDALENA	20	
MAINE	48	89	MALLORY LYKES	13	18	MALLOW WLB 396	7		MALMROS MONSOON	7	24
MAMMOTH FIR	27	54	MANHATTAN	23	99	MANHATTAN DUKE	36	102	MANISTEE	29	
MANUAWILI	111	181	MANUKAI	98	141	MANULANI	91	134	MANULEI	67	91
MANZANARES	10		MAR DE CORTEZ	10	50	MARCHEN MAERSK	9		MARCONA CONVEYOR	96	114
MARCONA EXPORTER	30	193	MARCONA TRADER	35	34	MARCONA TRANSPORTER	46	88	MARCONA VENTURER	17	
MARDI GRAS	35	25	MARGARET LYKES	32	70	MARIA TOPIC	5		MARINE CHEMICAL TRANSP	41	78
MARITIME ACE	6		MARITIME BRILLIANCE	9		MARITIME CHALLENGE	22		MARITIME HARMONY	4	
MARJORIE LYKES	1	26	MARY S	2		MASON LYKES	33	96	MATSONIA	79	143
MAUI	84	138	MAUPEE	28	101	MAYA PIONEER		81	MAYAGUEZ	25	129
MAYAYAN REEFER		6	MAYO LYKES	10	4	MC ARTHUR	42	101	MEADOWBROOK	2	22
MEDITERRANEAN CARRIER	30	32	MELVIN H. BAKER	75		MEONIA	50	118	MERCY	14	61
METEOR T-AKR 9	45	96	MIDAS RHEIN	6		MILLER FREEMAN	70	140	MINERVA	9	
MING AUTUMN	56	46	MING LEADER	6		MING SPRING	29	49	MING SUMMER	2	
MING YOUNG	15		MOBIL AERO		57	MOBIL ARCTIC	45	130	MOBIL LUBE	4	11
MOBIL POWER	30	84	MOBILE	7		MOBILE MERIDIAN	34	109	MOBILFUEL	14	34
MOBILGAS	19	65	MONMOUTH		54	MONTERREY	1		MONTICELLO VICTORY	19	75
MONTIGNY	11		MONTPELIER VICTORY	1		MOON RIVER		150	MORANT	34	
MORMACALTAIR	7	71	MORMACARGO	14	66	MORMACDRACO	11	45	MORMACLYNX	28	63
MORMACRIGEL	8	26	MORMACSAGA	27	57	MORMACSEA	14	69	MORMACSKY	10	46
MORMACSTAR	26	85	MORMACTIDE	9	82	MORMACVEGA	9	41	MORMACWAVE	4	38
MORNING GLORY	7	81	MOUNT VERNON VICTORY	32	57	MOZART FESTIVAL	9		MT MITCHELL	49	105
MUNRO WHEC 724	35	93	NAGARA	1	2	NANCY LYKES	24	63	NAVASOTA	1	62
NECHES	17	63	NEPTUNE RUBY	55		NEW ENGLAND HUNTER	6	7	NEWARK	34	115
NEWCASTLE CLIPPER	63		NOPAL LANE		3	NORDHVAL	43		NORDIC LOUISIANA	56	
NORDIC PRINCE	17	29	NORSE PILOT	48	88	NORTH STAR III	57	80	OAKBANK	1	
OCEAN DUKE	11		OCEAN HAPPINESS	44		OCEAN LOG	46	56	OCEAN PROSPER	2	
OCEANIC	80	174	OCEANOGRAPHER	127	69	OGDEN CONGO	27	135	OGDEN JORDAN	5	
OGDEN SENEGAL	1		OGDEN WABASH	4		OGDEN WILLAMETTE	4		OJI GLORIA	54	36
OLEANDER	100	66	OLGA TOPIC	11	67	ORANGE	8		ORCO MINER	9	
ORCO TRADER	12	33	ORE JUPITER	19		ORIENTAL COMMANDER	29	68	ORIENTAL EXECUTIVE	29	79
ORIENTAL FANTASIA	1		ORIENTAL LEADER	14	91	ORIENTAL SOVEREIGN	30	38	ORIENTAL STATESMAN	13	52
OTTO N. MILLER	3	189	OVERSEAS ALASKA	1		OVERSEAS ALEUTIAN	1	55	OVERSEAS ALICE	1	
OVERSEAS ARCTIC	31	98	OVERSEAS JOYCE		6	OVERSEAS JUNEAU	10	30	OVERSEAS NATALIE	17	23
OVERSEAS NEW YORK	16	26	OVERSEAS ULLA	1		OVERSEAS VALDEZ	1	21	OVERSEAS WASHINGTON	5	7
PACBARON	8	31	PACBARONESS	13		PACDUCHESS	13		PACDUKE	3	9
PACEMPEROR	7		PACGLORY	15		PACIFIC ACE	8		PACIFIC ARROW	129	87
PACIFIC ERA	50	99	PACIFIC EXPRESS	92	35	PACIFIC GLORY	47		PACIFIC PEACE	10	45
PACIFIC SAGA	45	116	PACIFIC VENTURE	28	142	PACIFIC WINS	11	151	PACKING	3	
PACLADY	4	26	PACMAJESTY	9	5	PACMERCHANT	6	12	PACPRINCE	9	
PACPRINCESS	29	33	PACSTAR	8	19	PAN ASIA	15	12	PAN PACIFIC	44	100
PARALLA	20		PAUL L FAHRNEY		140	PERRYVILLE	23	138	PHILADELPHIA	57	107
PHOSPHORE CONVEYOR	1		PINE LIGHT	5	10	PINK SKY	2		PIONEER COMMANDER	23	64
PIONEER CONTENDER	7	33	PIONEER CONTRACTOR	29	109	PIONEER CRUSADER	10	63	PIONEER MOON	27	73
POLAR ALASKA		176	PORTLAND	51	109	PORTMAR		33	PORTUGAL MARU	22	20
PRESIDENT ADAMS	28	52	PRESIDENT CLEVELAND	15	65	PRESIDENT EISENHOWER	24	55	PRESIDENT FILLMORE	25	91
PRESIDENT HARRISON	7	45	PRESIDENT JACKSON	18		PRESIDENT JEFFERSON	61	130	PRESIDENT JOHNSON	51	151
PRESIDENT KENNEDY	61	115	PRESIDENT MADISON	57	145	PRESIDENT MC KINLEY	47	133	PRESIDENT MONROE	8	39
PRESIDENT PIERCE	100	177	PRESIDENT POLK	58	112	PRESIDENT TAFT	47	76	PRESIDENT TAYLOR	28	80
PRESIDENT TRUMAN	75	136	PRESIDENT VAN BUREN	27	81	PRESIDENT WILSON	12	29	PRINCE OF TOKYO	37	
PRINCE WILLIAM SOUND	29	119	PROGRESSUS	56	64	PROSPERITY	11	5	PROVINCIA DE EL ORO	7	
PUEBLA	6		PURE OIL	26	83	PVT JOHN R TOWLE	8	19	PVT LEONARD C BROSTROM	4	
QUEENS WAY BRIDGE	92	67	QUINTINA	24	21	QUIXADA	8		RAINIER	6	10
RALPH B JOHNSON	1		RED ARROW	16		REGINA CELI	19		RELIANCE WMEC 615	38	
RESEARCHER	71	136	RESOLUTE WPC 620	46	48	REVERE		32	RICHARD	48	78
RIO OLIVIA	26	16	RIO TUXPAN	5		ROBERT E LEE	9	21	ROBERT TOOMBS	13	
ROBERTSBANK	15		ROSE	6	123	ROSE CITY	24	101	RUTH LYKES	16	71
SALVADOR	21	27	SAM HOUSTON	11		SAM RATULANGIE	27	19	SAMOA	32	86
SAMUEL CHASE	16		SAMUEL S	17		SAN FRANCISCO	16	77	SAN JUAN	98	174
SAN MARCOS	27	54	SANKOSTAR	15		SANKOSUN	10		SANSINENA II	23	125
SANTA BARBARA		26	SANTA CLARA	13	31	SANTA FE	9		SANTA MAGDALENA	17	28
SANTA MARIA	6		SANTA MARIANA	33	75	SANTA MERCEDES	54	97	SANTO AMARO	22	
SARGODHA	29	10	SEA FAN	12	24	SEALAND COMMERCE	54	133	SEALAND CONSUMER	42	90
SEALAND ECONOMY	64	99	SEALAND EXCHANGE	53	151	SEALAND FINANCE	36	88	SEALAND GALLOWAY	41	110
SEALAND LEADER	40	102	SEALAND MARKET	56	94	SEALAND MCLEAN	35	82	SEALAND PIONEER	26	111
SEALAND PRODUCER	14	114	SEALAND RESOURCE	21	99	SEALAND TRADE	73	149	SEALAND VENTURE	21	98
SEALIFT PACIFIC	14		SEATRAIN CONCORD	12	3	SEATRAIN INDEPENDENCE	58	118	SEATRAIN LEXINGTON	53	132
SEATRAIN PRINCETON	64	136	SEATRAIN TRENTON	92	184	SEATRAIN YORKTOWN	76	180	SEAWAY	25	111
SEAWAY DISPATCH	44	109	SEDGE WLB 402	6		SELANDIA	19	48	SENTINEL	20	40
SEPTA	12		SERAFIN TOPIC	2		SEVEN OCEAN	17	75	SHELDON LYKES	5	6
SHERMAN WHEC 720	1	22	SHING ON	9		SHIRLEY LYKES	18		SHUNWIND	33	91
SILVERLIME		140	SINCERE NO 3	4	70	SINCERE NO 5	3		SINCLAIR TEXAS	30	146
SKYWARD	20	20	SNOW STORM	16	83	SNOWLAND	39	110	SOCONY VACUUM		4
SOHIO INTREPID	1		SOLON TURMAN	2	14	SOUTHWARD	32	36	SPERO	7	
SPRUCE	18	95	STADT BREMEN	43		STAR DIEPPE		29	STAR DOVER	23	68
STAR HONGKONG	22		STARWARD	11	24	STATE OF MAINE	2	5	STELLA LYKES	33	
STOLT LLANDAFF	5	12	STONEWALL JACKSON	24	107	STREAM HAWSER	1		STUYVESANT	68	181
SUCCESSFUL VENTURE	30	19	SUGAR ISLANDER	22	15	SUNNY OCEAN	2	111	SUNWARD	6	6
SURVEYOR	128	172	SUSQUEHANNA	14		SVENDBORG MAERSK	32	69	SWEETBRIER WLB 405	12	
T F L INDEPENDENCE	38	117	T F L LIBERTY	16	86	TAMAROA WMEC-166		63	TAMPA	30	132
TANEY WHEC 37	11	39	TASSO		27	TAUBE	24	58	TEXACO ALASKA	1	
TEXACO FLORIDA	14	18	TEXACO KANSAS	1		TEXACO MASSACHUSETTS	6	8	TEXACO MISSISSIPPI	2	5
TEXACO MONTANA	1	41	TEXACO NORTH DAKOTA	3		TEXACO RHODE ISLAND	6	9	TEXACO WISCONSIN	4	26
TEXAS	22	39	TEXAS CLIPPER	34		TEXAS SUN		40	TFL DEMOCRACY	32	47
THOMAS E CUFFE	45	83	THOMAS G THOMPSON	12	39	THOMAS JEFFERSON	7		THOMAS LYNCH	38	
THOMAS NELSON	2		THOMPSON LYKES	28	56	THOMPSON PASS	28	38	TILLIE LYKES	14	123
TOBIAS MAERSK	20	27	TOMBEI MARU	40	15	TOKYO RAINBOW	10	48	TONAMI MARU	86	53
TONCI TOPIC	1		TOWNSEND CROMWELL	82	119	TOYOTA MARU 10	120	68	TOYOTA MARU 12	62	48
TOYOTA MARU #3	41	23	TOYOTA NO 24	25	39	TRANSCHAMPLAIN	44	83	TRANSCOLUMBIA	5	59
TRANSONEIDA	54	129	TREIN MAERSK	8	22	TRIUMPH	45		TROLL LAKE	74	
TROPICANA	14		UNION PROGRESS	2	26	UNITED SEA ANGEL	13	72	UNIVERSE	10	9
UNIVERSE KURE	40	166	VALLEY FORGE	39	47	VAN CONQUEROR	32	126	VAN FORT	23	65
VAN TRIUMPH	11	41	VAN WARRIOR	34	86	VANGUARD	14	39	VELMA LYKES	32	84
VENTUROUS WPC 625	12		VICENTE GUERRERO	14		VIGOROUS WMEC-627	10	57	VILLANGER	11	20
VIOLET	13	22	VOLNAY	23		WALTER RICE	23	150	WASHINGTON TRADER	17	46
WECOMA	120	124	WESER EXPRESS	33	97	WESTERN SUN	11	26	WESTWARD VENTURE	55	86
WESTWIND WAGB 281	104		WILLI REITH	57		WILMINGTON GETTY	64	102	WORLD PRIDE	8	
WORLD RUBY	2		WORLD SUPREME	9		WORTH	14	30	YAMASHIN MARU	132	109
YOCONA WMEC 168	13	20	YOUNG AMERICA	13	114	YOUNG SEAGULL	42	41	YUKON T-AO 152	14	90
ZENLIN GLORY	14	77	ZIM GENOVA	20	49	ZIM HONGKONG	13	28	ZIM MONTREAL	12	42
ZIM NEW YORK	62	72	ZIM TOKYO	60	117	ZOELLA LYKES	15	38	38N 71W	1	
ATJL	15	102	A8FC		16	A8MJ		2	A8TV	2	71
A8V1		15	BMDK	21	85	CSCW	14	51	DABR		48
DDCT		1	DGRL	2	14	DVXL		55	DZJF		101
DSAG	2	46	DSES	28	114	D5MC	20	39	D5NB	25	32
D5NW	106	125	D5OD	8	40	D5GM	6	28	D5GM	16	91
D5GC	62	102	D18P	2	6	D7EG		19	D7XX	9	40
D8OC	2	26	ELFY	4	148	ELJM	14	14	ELOU		21
ELPA		16	ELUD		1	FXLV		102	GPMU		17
GPWI		58	HODT	1	164	HOML	4	58	HOMV	14	31
HOGJ		20	H3AB	24	97	H3SY		107	H18Y		29
JBMT	18	63	JHAG	68	68	JJKE	27	27	JKMG	88	24
JLJM		10	JLJL	60	44	JPXT		28	JQRO	52	20
JRBX	7	10	KCAF		1	KESN	9	25	KFDV	25	65
KHOL		8	KHLL		38	KHLC	20	45	KJDG	35	112
KNMB		1	KPKL	19	85	KSFK	3	8	KSLJ	48	138
KTGR		11	KVFN	25	48	LEVM	13	49	LFEL	24	61
LMGG	3	7	LHUK	57	118	LIBD	12	29	NBSZ		131
NHMX		95	NHNF		55	NNBN		493	NOTS		6
NTRI	1	123	PPDI	9	25	PPJT	15	21	PYXV		61
S6IB	4	24	SGLP	8	159	SGLU	24	125	S6ED	23	40
S6MM	26	71	S6ZD		14	TCCH	37	52	WCDOG		1
WDZ8	10	65	WDZ6	2	95	WD6084	11	68	WFJK	82	131
WFQE	2	95	WIGI		26	WSNB	25	70	WVFY		14
WYS3261		55	WZY9373		58	ZCKD	11	17	ZCKV	12	7
ZFCB	23	74	OWNI		37	OYBQ		56	3EBA	2	3
3EBH	3	22	3EJE	2	30	3EGR	7	52	3EGU	5	9
3EXC	17	48	3FHS	32	68	5DOM		80	5LKT		4
5MSK	10	24	6ZJC	39	91	9VPV	16	52	9VNP	13	58
9VVD	40	115									

SUMMARY: GRAND TOTAL VIA RADIO 24868 GRAND TOTAL VIA MAIL 54167

Rough Log, North Atlantic Weather

October and November 1979

ROUGH LOG, OCTOBER 1979--In general the tracks of low-pressure centers were randomly scattered from the latitude of the Ohio River northward, east of the Rocky Mountains. There was a tendency of the tracks to group over the Great Lakes and up the U.S. East Coast to the vicinity of Newfoundland. Storm centers north of latitude 55°N tended to turn northward and dissipate as they approached Baffin Bay. The Great Lakes and East Coast storms joined over Nova Scotia to form the primary path. Southwest of Iceland the paths split again with some moving over the island and the others moving southeastward toward the Bay of Biscay. Climatology indicates three primary tracks; one from the Great Lakes into the Labrador Sea, another from the East Coast to Iceland, and the third from off the East Coast to the Faeroe Islands.

The Icelandic Low at 996 mb was normally located near 60°N, 28°W, 5 mb lower than normal. The 1023-mb Azores High was 4 mb higher than normal near 32°N, 35°W, and 5° longitude west of its usual position. The largest anomaly center was minus 9 mb west of Lands End. This negative area covered the northeastern part of the ocean north and east of a line from the Azores to Kap Farvel. Another negative elongated anomaly stretched from the Great Plains to Newfoundland with a 5-mb center. There was a positive 4-mb area over the central ocean associated with the Azores High.

The upper air flow at 700 mb was mainly zonal over the water with an anomalous closed LOW northeast of Kap Farvel. The trough over the U.S. East Coast was normal, but the one over the west coast of Europe was much sharper than normal. The ridge over central Europe was accentuated.

Although October is normally an active month for tropical-cyclone activity, there were no hurricanes nor tropical storms during the month. This is the only year on record in which there were eight or more storms prior to October and none during October. The only tropical cyclone during the month was a tropical depression which followed a meandering track in the northwest Caribbean Sea from the 12th to the 18th. A low-pressure system which showed some characteristics of a tropical storm developed south of Bermuda on October 23. Winds in this storm reached 75 mi/h as it crossed the North Atlantic shipping lanes before reaching Newfoundland on the 25th.

Extratropical Cyclones--There were more than usual especially severe storms this month. Most of the severe weather occurred over the eastern half of the ocean north of the Azores. Several storms could easily qualify for the Monster of the Month.

The first storm was a weak LOW over Cape Hatteras on the first day of the month. On the 2d a ship near 37°N, 67°W, reported 25-ft swell waves on the northwest side of the well entrenched Azores High. After the LOW passed over Newfoundland on the 3d, it started deepening. A tornado was triggered at Windsor Locks, Conn., killing three and injuring 400. Between 0000 and 1200 on the 4th the pressure plunged 17 mb to 975 mb near 53°N, 32°W. Another closed 986-mb center had formed south of the primary center near 44°N, 25°W (fig. 49). The SMAA was east of this one

Figure 49.--There were three LOWs alined north-south in the early afternoon of the 4th from near Iceland to about 44°N. The strongest was the center one.

with 55-kn winds. The TROLL PARK was south of the northern center with 45-kn winds, and the CARCHESTER was west of the center with 24-ft swells. At 1800 the AMERICAN LEGEND had 30-ft waves. On the 5th the AMERICAN ARCHER was 500 mi to the southwest with 28-ft waves. The ARTEMIDA had 50-kn winds. Winds of 50 to 55 kn continued south of the pri-

mary center. At 1200 the BRITISH TAMAR was 600 mi southwest of the 966-mb center (51°N, 25°W) with 20-ft seas and swells coded at 60 ft. The AMERICAN LEGEND was now near 47°N, 29°W, with 55-kn winds and seas of 41 ft.

On the 6th the winds were generally up to 45 kn, but the BURGENSTEIN (44°N, 20°W) found 55 kn. Some wave reports were 30 ft or higher. The secondary LOW had disappeared, but another formed on the 7th as the primary LOW started tracking northward. The winds were now in the 30's and waves in the 20's as the LOW was weakening. On the 8th a thunderstorm was reported by the LOIRE with the passage of a trough. By the 9th the primary LOW had dissipated, and the secondary LOW became the primary one. It stalled near 55°N, 15°W, to eventually disappear on the 12th.

A LOW tracked out of the Plains and across the Lakes. On the 1200 chart of the 9th another LOW formed east of this one over the Hudson River, and the new one moved over the water. It was moving south of a LOW over the Labrador Sea. The OLAU WEST was near Kap Farvel with 50-kn winds and 26-ft seas. The Hudson River LOW was racing eastward. On the 11th it joined the circulation of the previously described stationary LOW. As it sailed past OWS Charlie early on the 11th, she had 50-kn winds and 20-ft seas. At 1200 the winds were only 40 kn, but the waves were 30 ft. The AYAKS was to the north (61°N, 28°W) with 62-kn winds and 26-ft seas.

Figure 50.--The two comma-shaped cloud patterns near the center (50°N, 15°W) indicate areas of rough, unstable weather.

At 1200 on the 12th the 978-mb LOW was off Fastnet Rock (fig. 50). This was a bad day. The SPRAY CAP reported 68-kn winds near 41°N, 25°W. Several other ships had winds over 50 kn. The worst part were the waves. OWS Romeo suffered the worst with 46-ft waves. Among others the CIROLANA and GLENPARK had waves over 30 ft. The storm was moving southeastward into the Bay of Biscay. Waves of over 30 ft continued into the 13th.

On the 14th a maverick LOW moved into the northern part of the circulation, bringing in a new shot of energy. The PEARL ACE found that 46-ft area of waves. The SEA TRAIN LE HAVRE had 33 ft. The LOW moved ashore in Bordeaux country as the second LOW followed in a southeastward path. A third LOW now formed near Cape Finisterre.

At 1200 on the 15th this new LOW was 987 mb over northwest Spain. An area of high waves existed between 35° and 50°N and 10° to 20°W. The QUEEN ELIZABETH 2 (39°N, 13°W) had 39-ft waves, and the ROCKHAMPTON STAR (40°N, 13°W) had 41-ft waves. The winds were generally in the 40-kn category. On the 17th this LOW moved over Italy and disappeared.

This was one of the storms that traveled across the Great Lakes. It brought rain to the basin and snow north of Lake Superior. The center crossed into the Labrador Sea on the 14th. Early on the 15th the KBCG (47°N, 47°W) found 47-kn southerly winds. Later in the day the FRITHJOF was north of the center near 60°N, 46°W, with 70-kn northeasterly winds and 31-ft waves.

On the 16th the LOW glanced off the west side of Kap Farvel and traveled up the west coast. OWS Charlie had 24-ft waves as the occluded front passed. Another center materialized off the east coast and moved northeastward as the original LOW died on the barren west coast.

This LOW formed in a trough line that swung around the storm described above. A small center had formed by the 17th. A front had generated in the trough, and at 1200 on the 17th the USNS COMET and the JEAN LYKES were near the front (39°N, 39°W) with 58- and 48-kn winds, respectively. The center passed north of Charlie on the 18th, leaving 20-ft seas. The EUROBRIDGE BEAM (54°N, 33°W) and the MANCHESTER RENOWN (56°N, 26°W) both had 52-kn winds with the formed reporting 26-ft seas. Lima had waves of 25 ft on the 18th and 30 ft on the 19th. The 976-mb storm touched the southeast Iceland coast at 1200 on the 19th. The storm disappeared into the Barents Sea on the 21st.

This frontal wave was first analyzed on the 1200 chart of the 20th. Ships from Britain, Germany, and the United States were instrumental in identifying this new development. It intensified quickly to 990 mb near 47°N, 30°W, by 0000 on the 21st. At 1800 on the 20th the NORSE VIKING (42°N, 36°W) was hit by 68-kn winds,

and at 0000 on the 21st the NOVO MESTO (41°N, 36°W) had 60-kn winds. Slightly farther north (44°N, 36°W) the JADRON was pounded by 46-ft waves.

As the storm moved northward it deepened to 976 mb at 1200. The high wind band had moved northward to longitude 28°W. The CAST PORPOISE and DURHAMBROOK both found 55-kn winds at that longitude with the latter having 33-ft waves.

On the 22d the storm was approaching the Denmark Strait and curving westward. The GTOT (58°N, 09°W) found 50-kn winds in the southerly flow and 33-ft swell waves. On the 23d the rugged coast of Greenland took its toll.

The wild west of Montana produced this storm on the 19th. It raced across the Quebec and Labrador provinces at 55 kn and moved offshore near Hamilton Inlet early on the 22d. A good westerly flow already existed between a LOW over the Denmark Strait and the Azores High. At 1500 the WIDAR was near 54°N, 48°W, with 53-kn winds, when the LOW passed slightly to the north. By 0000 on the 23d OWS Charlie had 40-kn winds and 21-ft seas. At 1200 the LOW was 958 mb near 59°N, 28°W (fig. 51). A Soviet ship reported 68-kn winds and 26-ft seas near 57°N, 30°W. The NORDVIKINGUR at 60°N, 20°W, on the eastern side found 60-kn winds. At 1800 a French ship (FBLD) (60°N, 50°W) found a 70-kn wind band. The HOFSJOKULL (55°N, 37°W) was in 60-kn westerlies. Charlie now had 30-ft waves, and the same Soviet ship as before had 33-ft waves.

Figure 51.—The afternoon sun illuminates the clouds with the LOW and its front. The clear area between Ireland and Iceland delineates the change in air masses between the storm and high pressure centered over southern Norway.

Winds over 50 kn were still being reported on the 24th. For two ships high waves were the problem. The WELSH CITY (48°N, 27°W) was beaten by 43-ft waves. The passengers on the QUEEN ELIZABETH 2 (48°N, 32°W) were not enjoying their voyage with 41-ft waves crashing on the deck. There was a long slender area of high waves oriented northwest-southeast approximately centered on OWS's Charlie and Romeo.

On the 25th the strong southerly winds had reached the North Sea and were pounding the platforms with 40- to 50-kn winds and waves as high as 30 ft. The LOW had now curved toward the northwest, and the pressure was rising. On the 26th two new LOWs formed in the outer circulation. One of these passed almost directly over OWS Lima. That day the storm suddenly started moving eastward again, then northward to crash on the Greenland coast.

These two ships probably suffered their heavy weather damage with this storm. The 1,596-ton British ELOISEID encountered heavy weather between the 23d and 26th between England and Finland. The 6,640-ton Cuban 5 DE SEPTIEMBRE from Cuba to Rotterdam sought refuge at Lisbon on the 26th because of severe weather.

This storm began as a weak frontal wave between Bermuda and Cape Hatteras. It moved northeastward along the front until the 27th, when it started to deepen. At 1200 on the 28th the 992-mb storm was 200 mi east of Cape Race. The USNS COMET (36°N, 51°W) was east of the cold front with 48-kn southerly winds. At 1200 on the 29th the LOW was 976 mb near 53°N, 40°W. At 0600 the LOW had passed very close to the BILDERDYK with a pressure of 981 mb, 52-kn southerly winds, and 25-ft waves. At 1200 the wind was northwesterly at 50 kn and the waves 23 ft. At 1800 a SHIP report read 74-kn winds at 55°N, 85°E, which is in central Siberia. A wrong quadrant indicator I hope. On the 30th several ships reported winds near 50 kn, but most reported strong gales. Waves were up to 25 and 30 ft. At 1200 the LOW passed almost directly over OWS Lima with a pressure of 973 mb at Lima. As the center moved northward her winds picked up to 45 kn and the seas to 21 ft.

On the 31st the storm was nearly stationary near 62°N, 18°W. During the day Lima measured winds up to 60 kn. The platforms in the North Sea were straining under winds up to 65 kn at one near 61°N, 01°E. The RIG MASTER (60°N, 02°E) had 63 kn and waves of 39 ft. By 1200 on November 1 the 978-mb center was over Iceland and deteriorating as another LOW approached from the southwest. The storm disappeared on the 2d.

This severe weather over the Mediterranean was associated with a frontal system that was over the area from the 25th to the 27th. On the 25th 5 hr of torrential rain flooded Catania, Sicily. Two people were killed, and there was millions of dollars damage. The same day a severe thunderstorm struck the Maltese Islands and 68.2 mm of rain fell at the airport in a short time. Three people died in the worst storm to hit Malta in 25 yr. Severe flooding caused much damage.

On the 27th the 1,600-ton Cypriot NICOS developed difficulties in severe weather west of Marseilles and was taken in tow to the Gulf of Fos. The same day the

tug HANSA lost tow of the Tunisian MONASTIR near 36.2°N, 20.2°E, during a storm. The MONASTIR was later found aground on the southeast tip of the Gulf of Taranto.

At the same time Upper Egypt suffered the worst floods in 25 yr. The last count indicated that 42 people had been killed and 25,000 were homeless. Torrential rains wrecked villages, roads, and bridges; drowned animals; and destroyed crops.

Monster of the Month--This storm came from the Great Lakes. As it passed south of Newfoundland on the 31st the CAPE ROGER had the first gales and 16-ft seas. A ship near Miquelon Island had 45 kn. As the previous storm dissipated this one intensified. There was a long sweep of cold air behind the storm from Greenland to 25°N. A ship had 50-kn winds near Frederikshab. The KBCG (47°N, 47°W) had 47-kn winds and waves up to 20 ft were reported in the northerly flow.

On the 2d a second LOW joined the overall circulation south of the original one (fig. 52). The ORJEN (45°N, 47°W) found 55-kn winds from the north. Some waves were running up to 20 ft. At 0000 on the 3d the LOW had plunged to 958 mb. The buoy southwest of Iceland measured 40-kn winds. The drilling platforms in the North Sea were again being hit by winds over 50 kn. Waves over 30 ft were not odd. One near 61°N, 01°E, reported 52 ft; others were near 40 ft. Ships were not being discriminated against. OWS Mike measured 60-kn winds and 20-ft seas. The ECKERT OLDENDORFF (59°N, 22°W) found 56-kn winds and 46-ft swells at 1200. On her 1800 report the winds were 122 kn, but this was probably double the speed due to the conversion indicator. The observation was fantastic as the seas converted to 49 ft and the swells to 80 ft. The observation looked good as far as pressure, temperature, position, movement, etc., were concerned. On the 4th the C.P. DISCOVERER along 54°N reported swell waves of 49 ft twice. A platform near 62°N, 01°W, measured 46 ft waves. The storm was moving across the Norwegian Sea with a pressure of 949 mb. The storm finally broke up over northern Scandinavia.

This storm took its toll. The 8,633-ton Panamanian LEVANTINO suffered hatch cover damage on the 3d between Narvik, Norway, and Glasgow, Scotland. The 6,500-ton Greek freighter AEOLIAN SKY and the 1,000-ton West German cargo ship ANNA KNUPPEL collided in the stormy English Channel 30 mi southwest of the Isle of Wight. That same day the British motor vessel SAINT KENTIGERN ran aground on

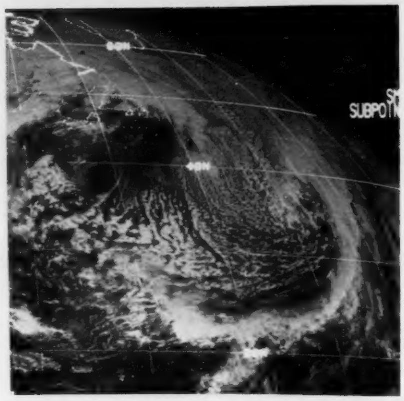


Figure 52.--Only the southern weaker LOW near 39°N, 34°W, can be seen in this SMS image. The stronger LOW is too far north. The clouds depict the long northerly and southerly wind flow connecting the two.

West Burra Isle in the Shetlands in force 9 to 10 winds. She sank almost immediately. The crew of six was later rescued from a liferaft by the ALERT. Early on the 6th the 1,028-ton POOL FISHER capsized in force 6 to 7 winds and rough seas off the Isle of Wight. There were only 2 survivors of the crew of 14, plus a wife.

Casualties--The 6,792-ton Great Lakes freighter FORT WILLIAM struck the Detroit River Light in heavy fog on October 1. The Spanish trawler NUEVO JORGE was stranded in fog near Cabo Quintres on the 1st. The British fishing vessel CONDUAN ran aground on Brown Point in fog on the 3d. The Dutch 1,599-ton LEIDSEGRACHT suffered damage in heavy seas on the North Sea on the 4th. On the same day the new floating drydock No. 910 broke loose in 60-kn winds from towing tugs. It went aground near 69.8°N, 31°E. The dock was designed to take vessels up to 150,000 tons. The 14 crewmembers were taken off by helicopter. The British fishing vessel MARGRETHE BOJEN capsized in the North Sea in 45-kn winds on the night of the 4th. All six crewmen were missing. The British fishing vessel ELLA GRETHE and the motor vessel BULKO collided in fog 20 mi east of Ekofisk. The former sank and the BULKO picked up her crew. The 6,376-ton Panamanian GABRIELE KOGEL reported heavy weather damage on the 13th at Szczecin, Poland, on a voyage from Brownsville. The 2,798-ton ferry BALTIC STAR ran aground outside Stockholm harbor in fog late on the 13th. All 350 passengers were safely evacuated. The Greek ANGELIKI suffered heavy weather damage on the 13th, 14th, and 15th from Santos to Malaga. The 500-ton Panamanian TRANSMAR ran aground in a heavy rainstorm in Port Au Prince Bay on the 14th.

Two tidal waves with crests up to 10 ft hit the French Riviera about 1400 local time on the 16th. The

sea pulled back up to 300 m, a drop of about 1 m, then surged ashore. Hundreds of boats were swept from their moorings, and many cars on coastal roads were engulfed. About a dozen people were drowned. Many were working on a breakwater at Nice. Many buildings were also damaged.

The 912-ton Norwegian BJORGVIN grounded in fog early on the 16th at Laksevag. All passengers were safely landed at Bergen. On the 17th the 7,538-ton ROMANZA embedded her bow in a rock face on the Greek island of Dhenousa in fog. All passengers and crew were transferred to other vessels. The British bulkcarrier LA CORDILLERA (25,552 tons) and the Greek tanker GEORGIOS (23,451 tons) collided in fog in the Dardanelles. The LA CORDILLERA later ran herself aground.

The AEGIS PIONEER was stranded on the River Seine in heavy fog on the 20th. The U.S. Great Lakes freighter G.A. TOMLINSON (6,598 tons) was blown against the harbor breakwall at Ashtabula, Ohio, on the 28th.

Other Casualties--The American cargo vessel PILGRIM sent a distress message after her cargo shifted in heavy seas and huge swell off Cape Town. The Panamanian ARAMBEE, assisted by a tug, collided with the TURGUT GUNERI while unberthing at Assab. She was in ballast and drifted in strong winds.

ROUGH LOG, NOVEMBER 1979--The weather patterns were more intense than the normals indicate. The Icelandic Low at 995 mb was normally located southwest of Keflavik but 8 mb deeper. The secondary Low over the Norwegian Sea was 9 mb lower at 996 mb. The Azores High at 1025 mb was off Lisbon 800 mi northeast of its usual 1019-mb position. Over the United States the pressure was slightly higher than normal over the northwest and eastern-central States.

There were several significant areas of pressure anomalies. There were three negative centers--two minus 9 mb associated with the two low centers of the Icelandic Low and a minus 3-mb center northwest of the Azores Islands. The two positive centers were positioned off Lisbon at 8 mb and another of 5 mb to the south of Sable Island.

In the upper air at 700 mb the primary long-wave trough stretched from Hudson Bay to west Texas. This is a retrograded position from its normal slightly west of the Appalachian Mountains. The normal long-wave trough over western Europe was displaced to eastern Europe. There was a short-wave trough along longitude 40°W.

The storm tracks differed considerably from climatology. A primary track extended from the Great Lakes across Labrador. Here it was joined by two storms from the U.S. East Coast. From Labrador the tracks were east-northeastward to a point south of Kap Farvel where a branch split northward toward the Denmark Strait and the other branch later turned northward to east of Iceland. An anomalous primary track stretched from the central Atlantic near 30°N, 45°W, to the Faeroe Islands.

During November wave climatology shows a 50-percent chance for waves higher than 12 ft over an area south of Iceland roughly bound by 50° to 60°N and 15° to 25°W.

There were no tropical cyclones this month, which ends this year's season. There were eight named storms in 1979--Ana, Bob, Claudette, David, Elena, Frederic, Gloria, Henri--of which five--Bob, David, Frederic, Gloria, Henri--were hurricanes. There was also one subtropical storm this year. The long-term average of named storms and hurricanes is 10 and 6, respectively, so that overall tropical storm/hurricane activity was below normal. However, the five landfalls of storms/hurricanes in the United States including three hurricanes and one major hurricane were near or above the long-term averages of three, two, and one, respectively.

For the first time in over a decade the Lesser Antilles, Puerto Rico, Virgin Islands, and southeast Florida were seriously threatened and affected by hurricanes. The Mobile, Ala., and Pascagoula, Miss., areas had their most intense hurricane of this century. Frederic was the first hurricane to strike Mobile directly since 1926. David made landfall just north of Palm Beach, Fla., and again at Savannah Beach, Ga. Other U.S. landfalls were tropical storm Claudette near Beaumont, Tex., which produced an unofficial report of 42 in of rain in 24 hr near Alvin, Tex., which would be a U.S. record; hurricane Bob in the New Orleans area as a minimal hurricane; and tropical storm Elena which had little effect on the upper Texas coast.

Frederic brought wind gusts of 145 mi/h to Dauphin Island, Ala., and a 12-ft storm surge which destroyed much of Gulf Shores, Alabama. The most intense hurricane of the season, and maybe of this century in that area, was David with estimated winds exceeding 165 mi/h while south of Puerto Rico. David devastated the island of Dominica, killing an estimated 56 persons and leaving 60,000 of the 80,000 residents homeless. David struck the city of Santo Domingo with about the same intensity and continued north across the Dominican Republic with devastating floods from torrential rainfall. The government of the Dominican Republic estimates the death toll at 1,200 with damages in excess of $1 billion.

In the United States death tolls in David and Frederic were each less than 15, most of them indirect. Bob and Claudette each caused one death. Damage from Frederic is expected to exceed $2 billion, which could make it the costliest U.S. hurricane in history. David and Claudette both caused over $100 million damage in the United States.

Extratropical Cyclones--The first few days of the month the ocean was dominated by an October storm. As this LOW moved over the Norwegian Sea, high pressure was the dominant feature from Spain to the eastern United States. Weak LOWs were found at various times in all quadrants around the high pressure. Several of the LOWs making up the storm track out of the central ocean occurred during this time. There were some minimal gale-force winds, and one had tropical characteristics. A frontal wave deepened rapidly over Lake Superior on the 8th, and a storm warning was issued for 50- to 60-kn winds with gales for Lakes Michigan and Huron. A ship reported 48 kn and 13-ft waves on Lake Superior.

The first significant marine storm of the month came out of the southwest. It raced northeastward with an

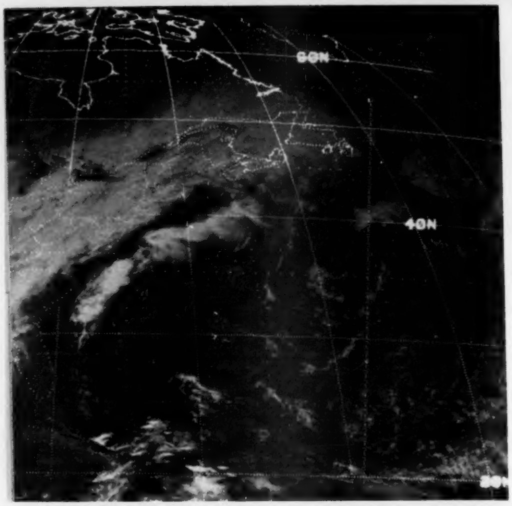


Figure 53.--The storm center near 50°N, 70°W, is not easily discernible at this time--1700 on the 10th. The high pressure feeding warm air into the Atlantic coast is centered near 40°N, 50°W.

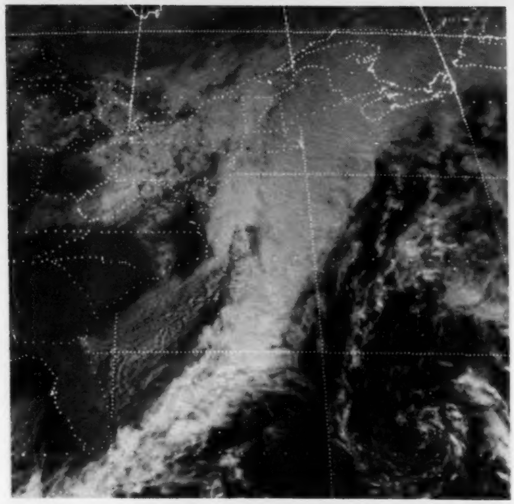


Figure 54.--The frontal wave at 1700 on the 14th was near 43°N, 70°W.

upper air short-wave trough until the 11th, when a closed circulation developed in the middle atmosphere. This slowed its eastward plunge. The storm tracked lengthwise across Lake Erie during the night of the 9th. This brought record cold temperatures to the Lakes on the morning of the 10th (fig. 53). This was in sharp contrast to the high temperatures along the mid-Atlantic coast, which was under southerly flow from a HIGH off that coast. The precipitation with this storm resulted in various locations, including Baltimore, exceeding their record yearly rainfall totals.

On the 11th two ships between Cape Race and Kap Farvel had 40- and 44-kn winds. At 0000 on the 12th the 986-mb center passed over Kap Farvel. At 1200 the storm was still deepening. The OLAU WEST near Kap Farvel had 70-kn winds and 39-ft seas. The report from the Kap itself was blurred on the chart, but it appeared to be 50 kn. The BAMSA DAN was nearby with 52 kn and 26 ft.

On the 12th and 13th the storm was traveling eastward at only 5 to 10 kn. At 1200 on the 13th the MANCHESTER RENOWN (56°N, 32°W) had 52-kn winds driving 25-ft seas with 49-ft swells. At 1800 the winds had increased to 55 kn with incredible 33-ft seas and 57-ft swells. Other ships around the area had waves up to 25 ft. At 0000 on the 14th her waves were down to 50 ft and by 1200 to 25 ft. Other ships in the northwest flow had joined the 25-ft wave club. On the 15th the high waves had reached OWS Romeo who recorded 33-ft seas. The AMERICAN ARCHER (48°N, 21°W) was battered by 39-ft seas and swells on her starboard quarter. A closed LOW had formed at the point of occlusion on the 14th over the English Channel. On the 16th this LOW absorbed the original one and moved inland.

This was one of a series of frontal waves that formed on a front that moved off the U.S. East Coast and was stalled by high pressure farther to the east. This particular wave was identified on the 12th. It traveled along the coast offshore (fig. 54). By 1200 on the 15th it was over Stephenville at 992 mb. The USNS COMET (36°N, 48°W) was between the front and the high, where the gradient had tightened, with 54-kn winds. Six hours later, as the front pushed eastward and the ship sailed westward, the winds increased to 58 kn.

On the 16th at 1200 the 976-mb storm was about 250 mi south of Kap Farvel. A Belgian ship near 53°N, 44°W, had 55-kn winds. OWS Charlie experienced 45-kn winds and 23-ft waves. On the 17th the point of occlusion passed directly over OWS Lima. She had almost 60 kn all day with maximum seas of 34 ft and swells of 49 ft. The DOCKLIFT II nearby estimated the winds at 70 kn but didn't venture out to check the waves. Early on the 18th the winds and waves at Lima relaxed as the storm moved eastward over the Faeroe Islands. Ships and platforms on the North Sea suffered 40- to 50-kn winds.

As the storm hit the Norwegian coast it deteriorated rapidly.

This Atlantic storm traveled more than half way around the world as an identifiable circulation. The LOW was originally identified over western Mongolia on the 3d. It traveled across the Bering Sea to the Beaufort Sea, then southeastward across Canada. On the 16th it was over the Gulf of St. Lawrence. On the 17th the MIFUNEASAN MARU (46°N, 53°W) found 50-kn winds off Cape Race. The storm deepened rapidly as its center crossed the coast. At 0000 on the 18th it was near Belle Isle at 974 mb. The CAPE ROGER was also off Cape Race with 68-kn winds, 28-ft seas, and 31-ft swells. Charlie was now under the influence of this storm with 45-kn winds and 20-ft seas. The MANCHESTER CRUSADE (52°N, 47°W) had 60-kn south-

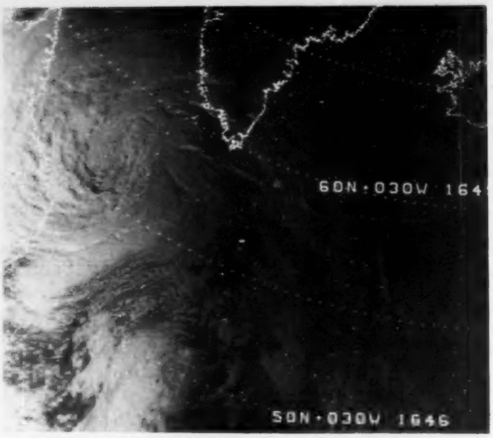


Figure 55.--At 1649 on the 18th the storm seems to be centered near 57°N, 53°W, in its cyclonic loop.

westerly winds with 26-ft waves. At 1200 the BRUARFOSS registered 964 mb near the 956-mb center with 52-kn winds.

The storm made a cyclonic loop on the 18th and 19th near 55°N, 50°W (fig. 55). Winds of 50 kn were the highest reported on the 19th. The C.P. VOYAGEUR also found 50 kn in the same area relative to the storm center on the 20th. The storm was weakening on the 21st as it moved toward Iceland. It moved across the Island on the 23d and disappeared on the 24th.

This small LOW developed over the desolate snow area of northern Quebec on the 23d. It moved across the Strait of Belle Isle. A cold HIGH from northern Canada was pushing southeastward and joined forces with another HIGH off the east coast of the United States. At 1200 on the 24th the LOW was 994 mb at 44°N, 45°W. The cold HIGH was centered south of Goose Bay feeding Arctic air over the warmer water resulting in high instability. The C.V. LIGHTNING (42°N, 51°W) was hit by 40-kn winds, 20-ft seas, and 30-ft swells. Not too far away the SEATRAIN TICONDEROGA (42°N, 48°W) suffered 53-kn winds but only 16-ft seas.

On the 25th the storm was 984 mb. There were many reports of storm-force winds and waves over 25 ft. The higher waves were in the southwest quadrant. The COUADONGA, NEDLLOYD ROTTERDAM, and SEA-LAND PRODUCER all found 33-ft seas. Mainly strong gales continued into the 26th with the sea and swell slacking off a bit. The EXPORT LEADER was sailing westward and at 0200 on the 26th near 38°N, 37°W, had 33-ft seas and 41-ft swells. She had started picking up 20-ft waves on the 0600 observation of the 25th. The windspeed gradually increased from 10 kn to 50 kn as the ship passed south of the center into the southwest quadrant (figs. 56 and 57). The swell waves were over 30 ft for over 15 hr. At 1600 on the 26th they had decreased to 16 ft, but they picked up again on the 0000 observation of the 27th to 30 ft. At 1800 the wind was 45 kn out of the northwest, and the seas were 25 ft with 49-ft swells.

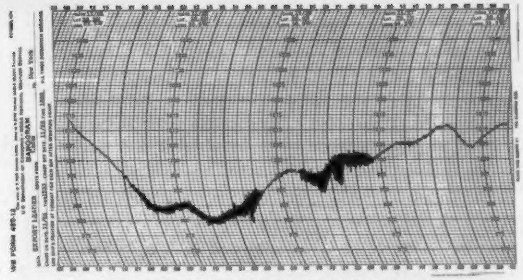


Figure 56.--The barogram of the EXPORT LEADER indicates she passed south of the center about 1900 on the 25th at 980 mb. It also indicates a secondary trough passage late on the 26th.

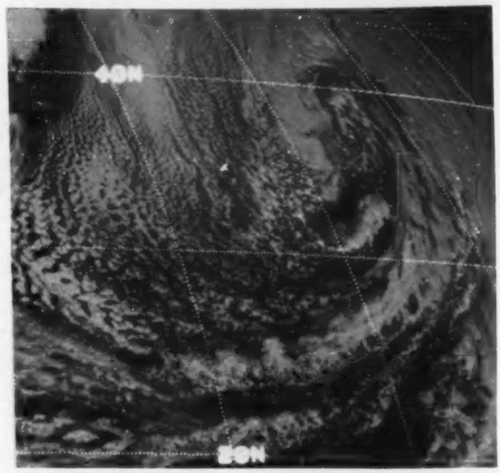


Figure 57.--The barogram and this 1700/25 satellite image confirm each other. The secondary trough is not apparent in the clouds at this time.

The winds and seas died down early on the 28th. There were two LOWs, another had formed south of this one, that made up the total cyclonic circulation which extended from north of Iceland to 30°N. It also covered the area east of 50°W to Europe.

On the 27th the RAEBURN (40°N, 39°W) was southwest of the center with 46-kn winds and 33-ft seas. OWS Romeo had 26-ft seas. Other ships had winds up to 50 kn and waves up to 25 ft. There were fewer reports on the 28th with the higher winds now associated with the northern LOW near Iceland. The SVALBAKUR near 67°N, 22°W, had 60-kn winds north of the Island. Others were in the strong gale to storm category.

The storm started moving northward at an accelerated rate on the 29th and filled. It passed north of Scotland and disappeared over Scandinavia.

This storm came out of the Oklahoma panhandle. Early on the 28th it moved over the Great Lakes as a frontal wave but immediately started deepening. On the 30th

the LOW was centered near 57°N, 43°W, at 972 mb. Some strong gales were being reported with 20 ft the maximum waves. The storm continued deepening, and at 1200, December 1 it was 954 mb west of Iceland. Several ships were reporting winds near 50 kn with the waves increasing to 25 ft. At 1800 a ship near 56°N, 38°W, estimated the wind as 68 kn. Waves of 20 ft reached southward past C7C.

By 0000 on the 2d the LOW was centered over Iceland at 946 mb. There were not too many ships reporting, but the GENERAL MADALINSKI (57°N, 36°W) reported 70-kn winds but no waves. Lima measured the swells as 28 ft. The C.P. TRADER near 52°N, 42°W, had 23-ft swells. As this LOW moved north of Iceland, another LOW formed east of Kap Farvel, elongating the circulation and keeping high winds and waves from Labrador to Norway. The MADALINSKI, sailing eastward, continued to have winds near 60 kn. The seas and swells were near 20 ft as far south as 50°N.

On the 3d the LOW was filling over the Greenland Sea. The second LOW was following as yet another formed near Kap Farvel.

Casualties--The Greek motor vessel BELA had rudder damage in the Ionian Sea on the 4th in stormy weather. The 499-ton Danish ERIK BOYE sank east of Gibralter on the 6th after a collision in fog with the 15,744-ton GOLDEN MIRANDA. The GOLDEN MIRANDA picked up all the crew safely. That same day in the same area the 5,977-ton DJATIMULIA and the 20,307-ton TEL-AVIV collided in fog. One crewman was killed and three injured aboard the DJATIMULIA.

The 579-ton Dutch ADRIANA had a cargo of barrels shift in heavy weather in the English Channel on the 6th. On the 15th the 1,599-ton Danish PETER SIF lost two containers in heavy weather off Ushant. Vessel took water and listed and sank on the 16th. All the crew were saved.

The Greek vessel SARONIC SEA (8,808 tons) was blown ashore from anchorage at the north end of the Welland Canal. The British BOSWELL reported heavy weather damage at Buenos Aires on a voyage from Britain.

Rough Log, North Pacific Weather

October and November 1979

ROUGH LOG, OCTOBER 1979--The low-pressure center tracks and the pressure pattern were a close rematch with climatology this month. There were two primary storm tracks. One came out of Siberia across Sakhalin Island, then eastward across the Bering Sea toward the Alaska Peninsula. The other track was from east of Japan, eastward to the central ocean, and then northeastward into the Gulf of Alaska. During the middle of the month two storms approached the California coast.

The 993-mb Aleutian Low was north of Unalaska Island. This was 8 mb deeper and 600 mi southwest of its normal location near Cook Inlet. The Pacific High was its normal 1019 mb astride latitude 30°N.

The major anomaly was minus 11 mb associated with the lower pressure and displacement of the Aleutian Low. Its center was near 55°N, 170°W.

The upper air flow at 700 mb was zonal with a trough over the eastern Asian coast and another along 160°W longitude. There was the usual ridge over the Rocky Mountains, only sharper. There was a closed LOW near the Pribilof Islands in place of the usual trough.

There were five tropical cyclones, two over the eastern ocean and three over the western ocean. The eastern North Pacific hosted tropical storm Hilda and hurricane Ignacio. The western North Pacific hosted tropical storm Roger and typhoons Sarah and Tip.

The U.S. West Coast was dry. On the 13th a 34-day period without rain was broken in Seattle when .01 in fell. This was the second extended period of dry weather in 4 mo. The first period was 32 days from July 12 to August 12.

Extratropical Cyclones--The first storm of the month formed over northern Honshu on the 1st as a combination of a weak extratropical LOW and dissipating typhoon Owen. By 0000 on the 2d it was 980 mb near 46°N, 158°E. A number of ships were in the area reporting gale-force winds and greater. The KAMENSKOIE (44°N, 155°E) found 48-kn winds and the highest seas of 34 ft. At 0000 on the 3d a Japanese ship (44°N, 173°E) was pounded by 35-kn winds and 25-ft swells. By 0000 on the 4th the storm was south of Unimak Island at 960 mb (fig. 58). Two ships near the center

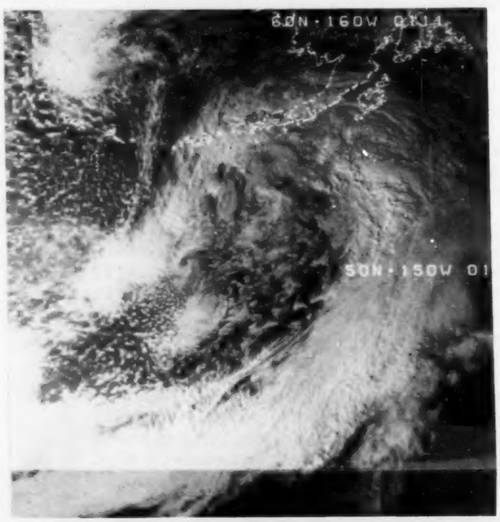


Figure 58.--An oval ring-shaped cloud appears to be associated with the storm center near 52°N, 165°W.

had 50-kn winds. The OCEAN BOUNTY was near Gore Point with winds up to 48 kn from the southeast. At 1800 the TROPIC FLYER (53°N, 148°W) was tossed by 44-kn winds and 46-ft waves. The PRESIDENT JEFFERSON about 90 mi south had 50-kn winds, but the waves were only 23 ft. On the 5th the NORDPOL (54°N, 152°W) fought 50-kn winds and 31-ft seas. On the 6th the storm broke up.

This storm formed on the 4th as a frontal wave east of northern Honshu as an extension of the front was being drawn into tropical storm Roger. A ship about midway between the two storms (33°N, 147°E) reported 44-ft swells from 200°. At 1200 on the 5th the HERMES (50°N, 162°E) had 980-mb pressure near the center of the storm with 40-kn winds and 20-ft seas. On the 6th the WESER EXPRESS (53°N, 171°E) was north of the center with 45-kn winds and 20-ft waves from the east.

By the 7th the 966-mb LOW was near 45°N, 170°W. A Japanese ship (JQVG) at 40°N, 177°W, was in the 55-kn high speed lane with 33-ft waves. At 0900 and 1200 three ships reported waves of 33 ft with two having 50-kn winds in the southwest quadrant. On the 8th most of the winds were in the gale category; but several ships had reports over 50 kn, including the CHEVRON CALIFORNIA with 65 kn out of the east near Cook Inlet. The TOYOTA MARU near 37°N, 169°W, had two observations of waves over 35 ft. The storm moved over the Alaska Peninsula on the 9th and magically disappeared as the next storm absorbed its circulation.

This storm formed east of Hokkaido on the 6th. It traveled northeastward as a frontal wave for 48 hr. Between 1200 on the 7th and 1200 on the 9th the LOW plunged 44 mb. The upper air support for this LOW moved southeastward from the Kamchatka Peninsula drawing the upper air support from the previous LOW northward and absorbing it. On the 9th the NOPAL LANE (38°N, 178°E) was sailing with 47-kn winds. The PRESIDENT ADAMS at 53°N, 176°E, had 50-kn winds and 26-ft waves, while the OHMINESAN MARU (60°N, 175°W) suffered chilling 55-kn winds out of the northeast with 21-ft waves on the 10th. The OCEAN BOUNTY was near Cook Inlet and reported gusts to 74 kn to WBH 29. The storm was 966 mb at 0000 on the 11th north of Unmak Island (fig. 59). The FINNISH WASA (48°N, 172°W) had winds of 50 kn.

The storm moved across Bristol Bay on the 12th and crashed into Mt. McKinley.

This storm came out of southern Siberia. It managed to cross the Kamchatka Peninsula on the 10th. It drifted over the Bering Sea until the previous LOW moved on. The first 40-kn winds were plotted on the 13th along the western Aleutians. At 0000 on the 14th the 980-mb LOW was near 54°N, 171°W. Another center had formed about 300 mi to the south. The ships had winds of 50 kn or greater. The SHINZUI MARU (49°N, 174°E) was sailing into 55-kn northwesterlies, 26-ft seas, and 30-ft swells. At 1800 the second LOW had been squeezed out, and the LEON PIERRE (49°N, 170°W) had 54 kn and 49-ft waves. On the 15th the PRINCE OF TOKYO (45°N, 168°W) battled 33-ft waves (fig. 60). Several ships had winds over 50 kn.

Between the 13th and 15th fishing vessels along the Aleutians between the Fox Islands and Cook Inlet were

Figure 59.--The near circular storm was north of Adak Island, when it was captured by the NOAA satellite on the 10th.

Figure 60.--The severe storms over the North Pacific this month seemed to favor a circular circulation, while those over the North Atlantic generally had a north-south elongated circulation.

battered by winds up to hurricane force. The OCEAN BOUNTY reported swells up to 32 ft at the entrance to Cook Inlet. On the 16th a Canadian ship east of Mackenzie Bay reported, but everything was garbled except its position and call letters--they may have been garbled also as it could not be identified. The storm was rapidly filling as it dawdled south of the Alaska Peninsula until the 18th.

Supertyphoon Tip was declared extratropical on the 20th near Ostrov Urup in the Kurile Islands. It was still an intense storm at 960 mb (fig. 61). At 0000 four ships had winds of 60 kn. They were broadly along longitude 145°E between latitudes 37°N and 44°N. The SINCERE No. 3 had 40-ft waves near 41°N, 152°E. Six hours later the NILE MARU verified the wave measurement only a few miles to the east. At 1200 the island of Ostrov Urup measured 50-kn winds. On the 21st the winds were decreasing to gale force with the waves over 30 ft. A ship near 45°N had 46-ft swells. As the storm moved across the Bering Sea on the 22d it disintegrated.

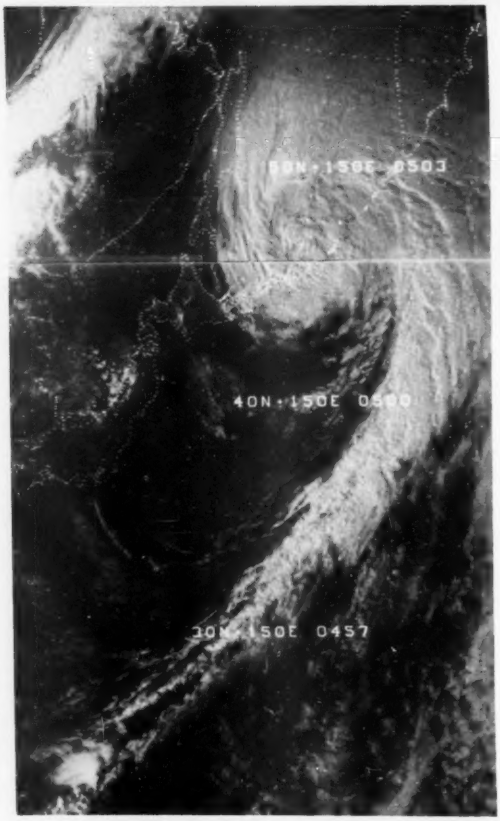


Figure 61.--Extratropical typhoon Tip does not appear as ominous here, but the strong winds generally cover a wider area in the extratropical stage.

Early on the 20th a cutoff LOW was centered near 33°N, 180°. There were three high-pressure cells northwest, northeast, and east of this LOW. A front stretched northeastward out of the LOW and between the two eastern high-pressure cells. On the 0600 chart a frontal wave formed on the front west of the HIGHs. The high pressure to the east rapidly broke down, and the LOW expanded while moving northeastward.

On the 21st many ships reported 40-kn plus gales south of the center. The ALSTER EXPRESS (42°N, 145°W) had 52-kn winds and 33-ft waves. At 0000 on the 22d the pressure had dropped to 956 mb near 48°N, 141°W (fig. 62). Among others OWS Papa measured 50-kn winds with 25-ft seas. Two ships near 38°N, 138°W, had swells approaching 40 ft. Buoy 46006 read out 30-ft waves. At 1200 the pressure reached 950 mb. Buoy 46004 had 956 mb and 24-ft waves at that time. Waves to 30 ft were recorded 700 mi south of the center. At 1800 the ASIA MORALITY (46°N, 163°W) and a ship near 47°N, 133°W, both had winds over 60 kn--66 and 68 kn, respectively. Another near 52°N, 133°W, had 31-ft swells. On the 23d a frontal wave moved in the southern part of the circulation and weakened the strong winds in that area. There were still winds over 40 kn and waves over 20 ft. On the 25th what was left of the storm crossed into Alaska near Valdez.

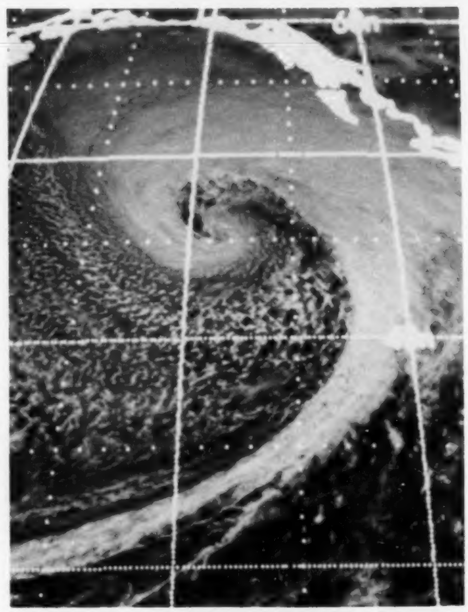


Figure 62.--At 2045 on the 21st the stationary satellite over 135°W caught the storm with this classical configuration.

A LOW moved out of Manchuria and into the Sea of Okhotsk. As it crossed the Kamchatka Peninsula, it split into two centers. This storm started with the center that remained over the Sea. It crossed the peninsula early on the 26th. At 0000 on the 27th the 988-

mb LOW was near 57°N, 173°E. The PRESIDENT JOHNSON (53°N, 171°E) had 47-kn westerly winds at 0600. On the 28th a ship had 45-kn winds and 23-ft waves. On the 29th another LOW was approaching from the west, and this one disappeared.

This LOW came out of Manchuria and crossed into the Sea of Japan on the 27th. At 1200 it was 990 mb over the Okhotsk Basin. A U.S.S.R. vessel reported 45-kn winds south of Ostrov Kunashir. Six hours later another ship north of the Island found 45 kn and 20-ft seas. On the 28th the KARSHOIE MORE had 56-kn southwesterlies at 0000 near 49°N, 152°E, with 23-ft seas. At 0600 the seas were 33 ft. On the 29th a sistership, the OKHOTSKOYE MORE, was north of the storm with 48-kn easterlies. The HAKUZAN MARU (50°N, 165°E) had 50-kn winds and 28-ft waves. In the southeast quadrant a ship had 20-ft waves, and one far to the south had 23-ft swells. The storm was tracking north of and parallel to the Aleutians. The fishing vessel BLACK HAWK (60°N, 152°W) had winds up to 55 kn. Later in the day and into the 30th the ALL ALASKAN sailing southeastward reported winds gusting to 70 kn south of Kodiak. As the storm crossed the Alaska coast south of Bethel, it weakened and was no longer significant as it entered the Beaufort Sea.

Tropical Cyclones, Eastern Pacific--Tropical storm Hilda began as a disturbance 200 mi south of the Guatemalan coast on October 1. Moving westward, the disturbance began to intensify and was upgraded to a tropical depression near 13°N, 104°W, at 0000 on the 4th. Tuna fishing boats were helpful in locating the center. The depression continued to intensify. The tanker ACILA helped to locate the center near 13.8°N, 108°W, at 1800. The depression then turned west-northwest. Tropical storm Hilda was christened near 14.6°N, 110.4°W, at 0600 on the 5th as winds increased to 40 kn. Shifting westward again, Hilda passed 250 mi south of Socorro Island at 0900. By 0000 on the 6th her winds had decreased to 30 kn, and the storm was downgraded to a depression near 15.1°N, 114.2°W, and dissipated near 15.8°N, 118°W.

Hurricane Ignacio began as a depression near 11.7°N, 95.3°W, at 1800 on the 23d. Winds near his center increased to 35 kn the following day, and he was upgraded to a tropical storm near 11.5°N, 97.9°W. On the 25th the storm was 300 mi south of Acapulco. It then turned toward the northwest and, moving at 9 kn, began to intensify rapidly over progressively warmer water. By late on the 26th winds had increased to 70 kn over 87°F water, and the storm was upgraded to a hurricane near 15.3°N, 104.3°W. On the 27th Ignacio turned westward and continued to intensify. At 1742 U.S. Air Force reconnaissance aircraft located the center of Ignacio near 17°N, 107.3°W. Winds near the center of the cyclone had reached their maximum intensity of 125 kn. The hurricane eye was reported with a well-defined closed wall 20 mi in diameter. Surface pressure was estimated at 938 mb. Reconnaissance aircraft made a second and third penetration. Surface pressure was estimated at 937 mb, and the eye was reported covered with low, broken clouds. Between 1800 on the 27th and 0000 on the 28th, several ships--the BODENA, LUTSK, PIONEER COMMANDER, and VERRANZANO BRIDGE--were helpful in locating the center of Ignacio.

Early on the 28th Ignacio turned northward and, slowing to 4 kn, began to weaken. At 1755 reconnaissance aircraft reported surface pressure at 969 mb and the eye, filled with low clouds, had decreased to a diameter of 5 mi. On the 29th Ignacio, generating 80-kn winds, turned eastward and continued to weaken. Winds near the center of the cyclone diminished to 55 kn by 1800. By 0000 on the 30th tropical storm Ignacio had moved to 75 mi southwest of Manzanillo, Mexico. Accelerating to 13 kn, he moved rapidly eastward toward the Mexican coast, making landfall 140 mi east-southeast of Manzanillo and 170 mi west-northwest of Acapulco. Remnants of Ignacio drifted across southern Mexico, dissipating over the Yucatan Peninsula on the 31st.

Tropical Cyclones, Western Pacific--Tropical storm Roger was a short-lived system. He was first spotted on the 3d about 300 mi west-northwest of Guam. Moving northwestward, he attained tropical-storm strength on the 4th after crossing the 20th parallel near 136°E. Maximum winds climbed to 45 kn as Roger accelerated north-northeastward. However, he never got beyond this intensity and began to turn extratropical on the 6th. But Roger did generate heavy rains and storm tides in the Tokyo area.

Meanwhile, typhoons Sarah and Tip were coming to life. Sarah developed in the South China Sea just west of Manila Bay on the 4th, while Tip sprung up the following day about 180 mi southwest of Truk.

While developing, Sarah caused problems in the Philippines. Torrential rains triggered flooding in the central sections where five children and a woman drowned. Meandering southward, Sarah reached typhoon strength on the 7th before moving across Palawan where she caused havoc. Taytay was severely damaged. Earlier the EVERWISE ran aground on Saddle Rock near Culion Island. Sarah's winds climbed to 90 kn as she swung west-northwestward on the 9th. She maintained this intensity until the 12th, when winds started to drop (fig. 63). By the time Sarah

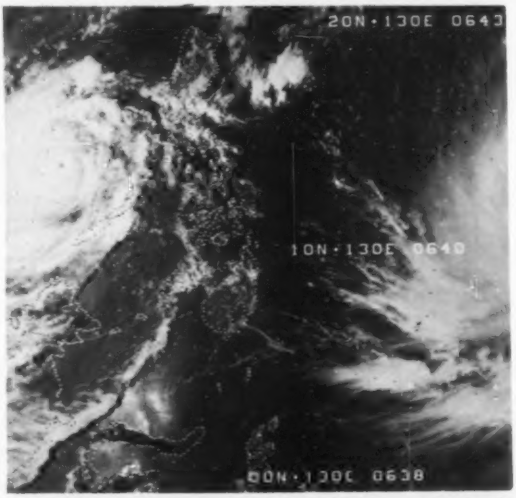


Figure 63.--Typhoon Sarah is on the left over the South China Sea. The western edge of typhoon Tip can be seen on the right.

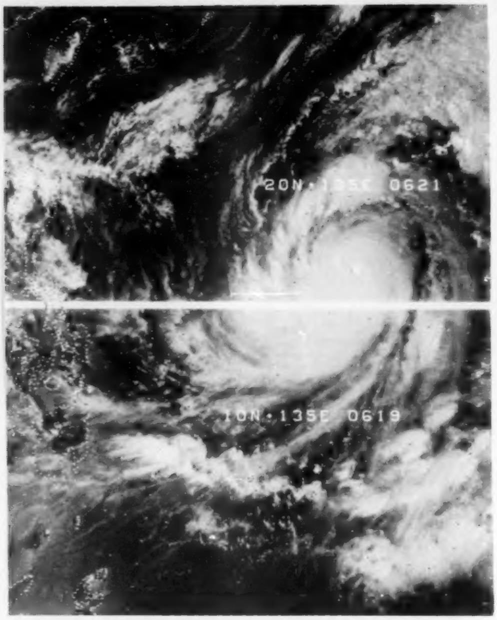


Figure 64.--Typhoon Tip on the 12th when a reconnaissance aircraft measured an 870-mb pressure, the lowest ever measured in a tropical storm.

reached the coast of Vietnam on the 14th she was a tropical storm. Sarah moved inland near Qui Nhon.

Meanwhile, Tip was developing into the blockbuster storm of the year. After passing Truk on the 8th and Guam early the following day as a tropical storm, Tip reached typhoon strength late on the 9th. Heading west-northwestward winds jumped to 110 kn early on the 11th and 135 kn 24 hr later. It was on the 12th (fig. 64) that a reconnaissance aircraft reported a dropsonde pressure of 870 mb--the lowest ever measured in a tropical cyclone. Even though ships were giving a wide berth to Tip, they were still encountering gale-force winds in 25-ft swells 200 to 300 mi from the storm's center. Among these ships were the IBARAKI MARU and the SHINNICHI MARU. Maximum estimated winds remained above 100 kn into the 16th. By this time Tip was beginning to recurve northeastward. Though passing 400 mi to the northeast of Luzon, the typhoon dumped heavy rains over the northern Philippines. To the north Kyushu and Okinawa were already being pounded by 25-ft waves. Although winds were dropping Tip was still a powerful storm as he moved up the Ryukyus and over Honshu on the 18th and 19th (fig. 65).

Ships grounded or sunk by Tip include the SHINEI MARU No. 11, YOO YEO No. 25, DONG WON No. 61, CHIL BO SAN No. 1, and the GELATIK. The GOLDEN VALLEY collided with the WORLD HERCULES. The YING SHAN went aground off Cape Erimo, Hokkaido, and was then broken in two by mountainous seas (fig. 66). Overall at least 44 fishermen were dead or missing in various incidents off Hokkaido. Onshore the typhoon also raised havoc. More than 22,000 homes were flooded, and there were more than 600 landslides. A fuel tank fire, triggered by Tip, washed away the tank supports and killed two and injured 42 American marines at a joint U.S.-Japanese military training center at the base of Mt. Fuji. Throughout Japan a total of 42 people died, 71 were missing, and 283 injured.

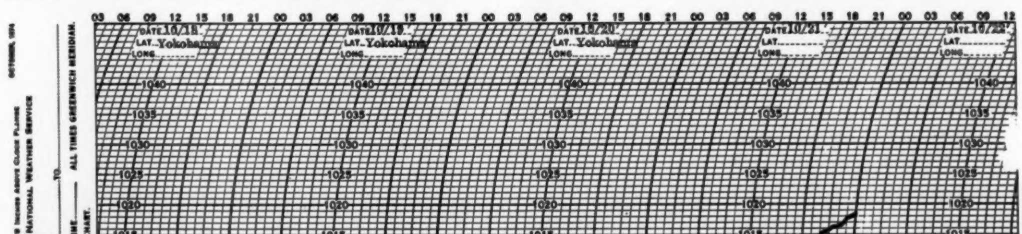


Figure 65.--The CHARLESTON was anchored at Yokohama when Tip passed nearby and produced this barograph trace.

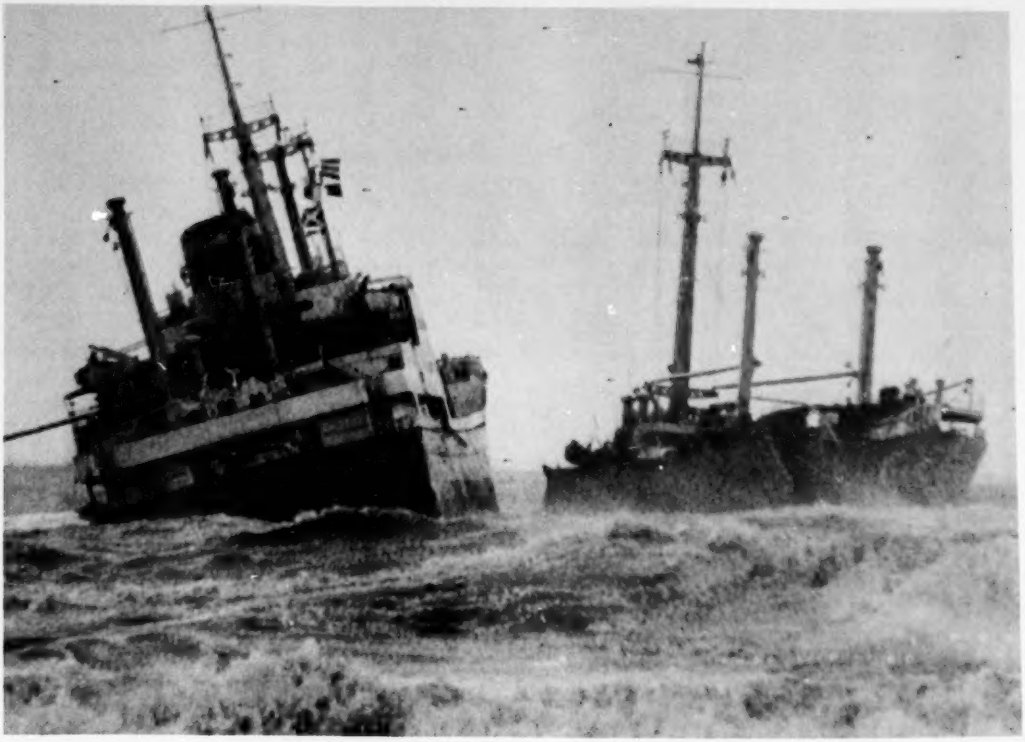


Figure 66.--The Chinese freighter YING SHAN broke in two after running aground in rough seas off southern Hokkaido. Gusty winds delayed rescue of the 46 crewmembers. Wide World Photo.

Casualties--The 44,875-ton American BEAVER STATE requested heavy weather damage survey on the 21st at Kagoshima that occurred earlier in the month. The ZIM SYDNEY enroute to Hong Kong on the 9th found heavy weather. The 6,720-ton Pakistani SAFINA-E-HAIDER was at Mojii on the 12th with heavy weather damage. The 16,371-ton JAPAN ERICA knocked out a span of the Canadian National Railways Bridge over the Second Narrows in heavy fog on the 12th.

The 10,186-ton Indian APJ PRITI reported heavy weather damage at Chiba. The 32,713-ton Liberian HONSHU GLORIA sustained heavy weather on the 19th and 20th. On the 23d the 23,000-ton Indian HARGOBIND was at Ogishima with weather damage. The Greek BLUESKY reported heavy weather damage at Singapore. The 14,529-ton British EASTERN SAGA requested a weather-damage survey at Osaka on the 26th. The 2,956-ton Japanese TAKEO MARU overturned in heavy seas at Shakhtersh Port on Sakhalin Island on the 29th. Twelve crewmen died, and eight others were missing. Only one was safe but injured.

Other Casualties--The Taiwanese VICTORY GODDESS and SCHWARZHEIDE collided in a sudden gale on the 26th off Shuaiba Roads. The Panamanian COURTEOUS lost an anchor off Port Kembla on the 27th during heavy weather.

ROUGH LOG, NOVEMBER 1979--There were two principal cyclone tracks across the North Pacific that affected mariners. One was from east of Honshu northeastward into the Bering Sea and then across the Bering Strait. The other was a conglomeration of tracks into and over the Gulf of Alaska. Over the western part of the ocean these tracks were shifted approximately 5° latitude northward, reflecting higher than normal pressures.

The monthly mean sea-level pressure centers were more intense than normal. This was especially true of an anomalous high-pressure center of 1027 mb near 35°N, 150°E. The normal Pacific High off the North American west coast was 1021 mb near 32°N, 128°W, which was about 250 mi east of its usual 1020-mb center. According to climatic normals, the Aleutian Low has three centers of 1001 and 1002 mb along latitude 53°N between 145°W and 175°W. This month the mean LOW was 997 mb near 62°N, 170°W.

The HIGH over the U.S. Great Basin was 6 mb higher than normal at 1025 mb. The Asian High over central Asia was 1041 mb versus the 1032-mb normal.

There were two large significant anomaly centers as a result of the pressure differences and positions. A minus 11-mb center was slightly north of the Bering Strait. A large positive 11-mb center was near 40°N, 153°E. This large area influenced the ocean

weather from the Aleutians south to 20°N and from the Asian coast to 160°W.

In the upper air at 700 mb the flow was zonal from the Asian coast to near 150°W. A closed upper air LOW was centered over the Arctic coast near 70°N, 170°E. Troughs extended both southeastward and southwestward from this center. The southeastward trough was much sharper than normal and, in conjunction with a sharp trough over the central United States, produced a sharp ridge over the Rocky Mountains.

There were three tropical cyclones this month, tropical storm Jimena in the eastern North Pacific and supertyphoon Vera and tropical storm Wayne in the western North Pacific Ocean.

Extratropical Cyclones--There were fewer individual cyclones this month than usual as they were generally large severe storms. The weaker circulations were transient. The same generally applied to the anticyclones. On the 24th one large 1049-mb HIGH dominated a large part of the ocean. The last third of the month the high-pressure areas averaged near 1035 mb. These together with deep low pressures resulted in very tight gradients and high winds.

This LOW developed near Hokkaido late on the 1st between three other pressure centers--a HIGH over China, another east of Tokyo, and a LOW over eastern Siberia. Gale-force winds started on the 3d. On the 4th at 0000 the LAKE TAHOE was near 43°N, 171°E, with 50-kn winds. Three hours earlier the JLPE (49°N, 175°E) found 39-ft swell waves; at 0600 they were still 33 ft. At 1200 a ship near the 969-mb center with a pressure of 971 mb had what appeared on the plot to be 60 kn. On the 5th at 1800 the PVT. L. C. BROSTROM was near a frontal wave southwest of the LOW and had 50-kn winds. Ships near the parent storm were reporting 20- to 33-ft waves. On the 6th the storm was nearing the Bering Strait. It moved over the Arctic Ocean on the 8th.

This storm was a combination of LOWs that formed and dissipated with a continuity of the overall circulation and storm. The original impulse and storm came out of Mongolia. This LOW disappeared over the Kamchatka Peninsula on the 7th. Meantime, another LOW had formed over the Kurile Islands late on the 5th. This strengthened the gradient between the 978-mb LOW and a 1030-mb HIGH centered near 33°N, 175°E. Waves up to 20 ft were found in the warm sector. Strong gales were reported on the 6th with 25-ft swells at 1200 near 40°N, 163°E.

By 1200 on the 7th the LOW was 964 mb near 55°N, 165°E (fig. 67). The circulation extended from Sakhalin Island to Alaska. The SHINKYOKU MARU at 51°N, 164°E, was fighting 40-kn chilling winds and 33-ft swell waves. The NOAA ship DISCOVERER near Nunivak Island measured 48-kn southeasterly winds with 10-ft seas and 20-ft swells. Other 50-kn wind reports and waves to 20 ft were as near as 300 mi of the center and as far as 1,000 mi away.

On the 8th there were several wind reports of 55 to 60 kn. The WRANGELL MARU (46°N, 155°E) took the honors with 33-ft waves with the OCEAN CROWN (40°N, 144°E) at 30 ft taking first runner-up. At 1200 the analysis indicated three LOWs comprising the main

Figure 67.--The storm appears weak due to the poor reflection from the Sun because of the high latitude and low Sun angle. The upper air long-wave pattern is clearly visible where the Sun reflects off the edge of the cloud shield.

center with another over the Bering Strait. One of the three LOWs raced northeastward and at 0600 on the 9th was north of Nunivak Island. The DISCOVERER was now southeast of Saint George Island with 62-kn southwesterly winds and 39-ft waves. On the 10th the last LOW was approaching the Bering Strait with only minimal gales. The storm continued into the Beaufort Sea and crossed back into Canada near Mackenzie Bay on the 12th. It finally crossed into the Atlantic late on the 17th and is described in that Log.

In the beginning this was another complex storm system. On the 11th there was a small intense LOW east of Honshu. The SHINANO MARU reported 55-kn winds about 200 mi southeast of the center. The SEA-LAND COMMERCE (35°N, 145°E) had 30-ft swell waves. The FINNISH WASA (36°N, 152°E) had 60-kn southerly winds On the 12th this LOW disappeared as the whole system developed. On the 11th another LOW was over the Sea of Okhotsk. On the analysis of 0000 of the 13th it appeared that this LOW would become the primary storm. The CRESSIDA in the southerly flow southeast of the center had 50-kn winds and 30-ft waves. A station on the west coast of Kamchatka measured 50-kn winds. On the 14th this storm started falling apart as the major storm approached.

This frontal wave that became the major storm formed on the front out of the LOW above east of Tokyo on the 12th. It traveled northeastward along the Japan Trench. At 1200 on the 14th it was 978 mb near 52°N, 169°E. The JAPAN ACACIA near 47°N, 164°E, had 50-kn winds and 20-ft swells.

By 1200 on the 15th the storm had moved to 60°N, 171°W, at 944 mb. In that time the SPRUCE had been on the 68-kn express. The AKADEMIK PETROVSKIY and KASHIMA MARU both had 60-kn winds. The CRESSIDA was still fighting 30-ft waves. On the 16th

the CGC MELLON east of Saint George Island had 50-kn winds and waves near 20 ft. The KENKON MARU (49°N, 175°E) had 25-ft waves for nearly 24 hr. The storm stalled near 61°N, 161°W, before dissipating on the 18th. The SHINZUI MARU (53°N, 156°W) found 60-kn winds and 33-ft waves on the 17th. Buoy 46003 registered 31-ft waves. On the 18th another LOW was moving along the Aleutians.

This frontal wave was analyzed south of Kyushu on the 17th with the aid of island and ship observations. It brought heavy rain to Japan as it moved northeastward. The NELSON MARU (38°N, 146°E) had southerly gales with 33-ft swells. The storm raced eastward along latitude 46°N. It was near 46°N, 170°W, at 0000 on the 20th. The winds were near 40 kn, but two ships near 38°N, 164°W, and 40°N, 166°W, both reported 48 kn with 20- and 23-ft waves. At 1200 a SHIP (46°N, 154°W) was pounded by 33-ft swell waves. The LOW now suddenly turned northward and deepened to 950 mb at 0000 on the 21st (fig. 68). There were many 50-kn wind and 30-ft wave reports. The SPRUCE was near 49°N, 140°W, with a report that read 97 kn and 41-ft seas and swells. The TOYOTA MARU No. 2 found 46-ft swells. A SHIP at 44°N, 154°W, radioed 75-kn winds. The SINCERE No. 5 (43°N, 160°W) also was battered by 41-ft swells. At 1200 a weather station on the Queen Charlotte Islands measured 60-kn southerly winds. Buoy 46006 measured 26-ft waves.

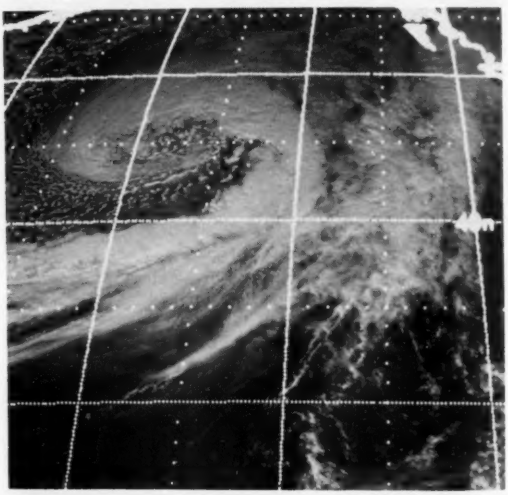


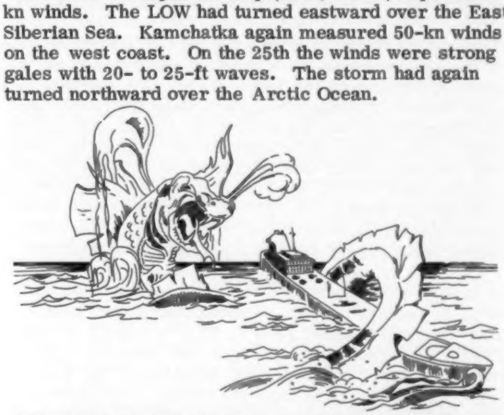
Figure 68.--The storm was intensifying rapidly over the primary shipping lanes when this image was obtained late on the 20th.

At 0000 on the 22d the LOW was 950 mb near 56°N, 145°W, and covered the area north of 35°N and east of 180°. The ALASKA STANDARD (58°N, 151°W) had 60-kn winds, and the RIVER ROSE (47°N, 137°W) estimated 78-kn winds. The ARCO JUNEAU (54°N, 136°W) was pounded by 38-ft waves, while a ship near 42°N, 153°W, suffered 43-ft waves. On the 23d the LOW rapidly broke down.

This short-lived storm was born in the trough of a LOW over Seward Peninsula late on the 17th. At 0000 on the 18th the SINCERE No. 5 near 44°N, 173°E, was near the trough line with 28-ft seas and 33-ft swells. The SHINZUI MARU (53°N, 157°W) reported 60-kn winds, 25-ft seas, and 33-ft swells. At 0000 on the 19th the 970-mb storm was near 52°N, 158°W. This day there were several ships with high winds and/or waves. The PRESIDENT TAYLOR (46°N, 161°W) had 33-ft waves; the ALEUTIAN DEVELOPER (56°N, 155°W) had 50-kn winds; the SPRUCE (51°N, 150°W) fought 62-kn winds, 33-ft seas, and 46-ft swells; and the STAR BOXFORD (52°N, 138°W) had 33-ft swells as did the ZELG (45°N, 152°W). On the 20th the STAR BOXFORD (53°N, 140°W) reported 81-kn winds out of the south-southwest with 33-ft waves. Late in the day the storm moved over Cook Inlet and decayed rapidly.

The intense Siberian High moved southward and broke down during the third week of the month. A LOW formed over central U.S.S.R. and moved eastward until the 23d. At that time it was pushing a 1048-mb HIGH over the eastern ocean; it turned northward before crossing the coast. The tight gradient between the two pressure systems produced high southerly winds. At 0000 on the 23d the LOW was near 59°N, 149°E, and the HIGH was near 43°N, 170°E. There were three reports of winds over 45 kn. A weather station on the west coast of Kamchatka measured 40 kn and one on the east coast 50 kn.

The SHINZUI MARU was having a tough voyage. On the 24th at 45°N, 158°E, she had 60-kn winds and 23-ft seas and swells. The VAN CONQUEROR (44°N, 171°W) on the east side of the HIGH had 40 kn, and the swells were 30 ft. A Japanese ship (51°N, 173°E) reported 60-kn winds. The LOW had turned eastward over the East Siberian Sea. Kamchatka again measured 50-kn winds on the west coast. On the 25th the winds were strong gales with 20- to 25-ft waves. The storm had again turned northward over the Arctic Ocean.



Monster of the Month--The seemingly insignificant reports from two ships located this frontal wave north of Hawaii on the 25th. It deepened very rapidly from 1012 mb to 996 mb in 12 hr. At 0000 on the 26th two ships near 32°N, 158°W, both had 50-kn winds with only one reporting waves, but the waves were 33-ft swells. Originally, the upper air LOW was cut off, but a strong trough absorbed it on the 26th and the surface LOW turned northward (fig. 69).

Early on the 27th winds were blowing in the 40-kn category with wave reports up to 25 ft. The FENBANK (35°N, 141°W) and THOMAS E. CUFFE (36°N, 163°W) were exceptions with 60-kn winds and 31-ft waves, respectively. The storm was 953 mb near 45°N, 145°W, at 1200. Later in the day the storm picked up consid-

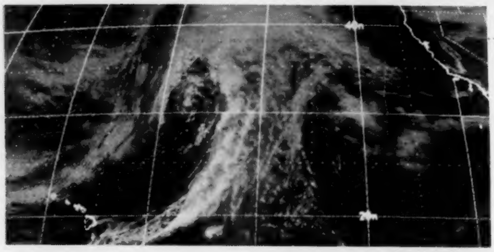


Figure 69.--The storm has an elongated configuration as its eastern movement is impeded by high pressure at the surface over the Pacific Northwest and a sharp upper air ridge off the West Coast.

erably. Among others the NORTH STAR III (50°N, 142°W) had 60-kn winds and 54-ft swells from the southeast. In verification the TAIKAI MARU (50°N, 144°W) reported 61 kn and 44-ft swells.

The winds and waves continued into the 28th. The ARCO SAG RIVER (56°N, 144°W) had 62-kn winds and 82-ft waves. The PHILADELPHIA (58°N, 147°W) had 70-kn winds and 82-ft waves also. Other ships reported 40- to 50-ft waves. By 1800 the reports had decreased to a mere 30 to 35 ft. The ARCO FAIRBANKS had 60-kn winds on the 29th with 30-ft waves. At 1200 the 973-mb storm was over Port Moller and then turned back southeastward. A U.S.S.R. ship south of Unimak Island had 60-kn winds. Another LOW had formed in the southeast quadrant and moved toward the coast. The two storms combined and produced strong gales and 20-ft seas. On December 1 both storms disappeared.

Tropical Cyclones, Eastern Pacific--The final cyclone of the season began as a tropical disturbance 80 mi south of Panama on the 13th. By the 15th satellite imagery showed cyclonic circulation about the center and the disturbance was upgraded to a tropical depression near 8.5°N, 88°W. Winds increased to 35 kn by 2100, and the depression was upgraded to tropical storm Jimena near 8.5°N, 90.5°W. By 0000 on the 16th Jimena was near 8.5°N, 91°W. She then turned west-northwestward and continued to intensify. The cargo ship NORSE PILOT and the passenger liner ISLAND PRINCESS helped to locate the cyclone near 9°N, 93°W, at 1200. Winds increased to their maximum intensity of 55 kn later in the day. Jimena then turned northwestward and reached 10.8°N, 95.7°W, early on the 17th. She turned westward again and began to weaken over 82°F water and under the influence of the Tehuantepec winds flowing in from the north. The following day winds had decreased to 30 kn, and the storm was downgraded to a depression.

Tropical Cyclones, Western Pacific--Supertyphoon Vera was first detected some 300 mi west of Truk on the 2d. Moving west-northwestward Vera achieved typhoon status the following day as she brushed Yap. By the 4th maximum winds climbed to 130 kn, and Vera peaked before reaching the Philippines (fig. 70). The 1,992-ton Panamanian HOI ON for Hong Kong sank about 310 mi to the south-southwest on the 4th. She was carrying 1,500 tons of logs. The crew of 25 was rescued. Vera was still generating 95-kn winds as she moved northward across Luzon on the 6th. She wreaked havoc among the northern tobacco farmlands. However, the rugged terrain took its toll, and Vera emerged as a weakening tropical storm as she crossed the Babuyan Channel on the 7th.

Figure 70.--This composite satellite image for early on the 5th shows Vera approaching Mindanao.

Less than 1 day later tropical storm Wayne popped up about 600 mi to the east of Luzon. By the 9th he was a tropical storm heading northward. His winds climbed to 50 kn on the 10th as the slow-moving storm crossed the 18th parallel near 129°E. By the 12th Wayne, now weakening, was only about 100 mi farther north. However, as he dropped back to depression strength Wayne headed southwestward toward the Philippines. On the 13th the weak storm came ashore across Dingalan Bay in southern Luzon.

Casualties--The 34,026-ton Dutch AMSTELMEER was at Kobe on the 2d with heavy weather damage. The barge PHILIP F. from Tacoma in tow by the tug GODFATHER arrived Honolulu with heavy weather damage. The 4,351-ton Thai NAKORNTHON dragged anchor in strong winds off Osaka and contacted the NISSHO MARU. The RYUYO MARU carrying 700 tons of fish grounded on rocks off St. Paul Island on the 8th during storm-force winds and heavy seas. The 2,712-ton Japanese MEIWA carrying 3,692 tons of steel sank southeast of Kushima on the 11th while trying to take shelter in Shibushi Bay from high seas. Two of the 20 crewmembers were rescued. The Japanese TURBO grounded in heavy rain and hurricane-force winds at Armuelles on the 13th. The CELEBRATION VENTURE requested heavy weather survey on arrival at Tamano.

The Japanese SUNGRACE departed Portland on her maiden voyage to Japan and encountered heavy weather on the 21st, which resulted in the death of two crewmen. Also Japanese, the 10,780-ton KEY GLORY encountered heavy weather on the 21st. A cargo of logs shifted and she returned to Tacoma. The American fishing vessel OCEAN PRIDE sank near Unimak Island during heavy weather on the 26th. The crew was safe.

The American B.T. SAN DIEGO sustained heavy weather damage, Valdez to Panama, on the 26th and 27th. The Liberian SEATRAIN CHESAPEAKE, Oakland for Kobe, encountered heavy weather and lost containers overboard.

Other Casualties--The 16,366-ton Greek ATTICOS reported contact with quay during heavy weather at Madras on the 25th.

Marine Weather Diary

NORTH ATLANTIC, FEBRUARY

WEATHER. Usually the weather over the North Atlantic during February is a continuation of the storminess characteristic of January, and there are years when February weather is the most severe of winter. The average pressure distribution remains quite similar to that of January. The Icelandic Low fills to 1004 mb and is located near 60°N, 40°W. The central pressure of the Azores High drops to 1021 mb near 32°N, 22°W. This reduction in the average north-south pressure gradient is caused both by LOWs being less intense on the average during February, and by the more frequent appearance toward the advent of spring of a blocking HIGH at higher latitudes.

WINDS. Over most of the ocean north of 40°N, the prevailing winds are westerly. The winds over the Norwegian Sea are variable. North of 60°N, between Greenland and Norway, the winds vary about equally from westerly to southerly. West of the Bay of Biscay, the winds are variable. Between 25° and 40°N, the wind direction favors the southwest quadrant in the Atlantic. The direction along the Atlantic Coast of the United States is northwesterly to variable off Florida. Over the Gulf of Mexico it is northerly to southeasterly. Westerly to northwesterly winds dominate the Mediterranean Sea. Force 3 to 5 winds are the most common except off the coast of the Middle Atlantic States, where force 4 to 6 winds prevail. In the ocean bounded by approximately 45°N, 30°W, the Denmark Strait, and the Labrador Sea, force 5 to 7 prevail. The "northeast trades," 25°N to the Equator, blow 65 percent of the time with speeds of force 3 to 5.

GALES. Winds of force 8 or greater occur over 20 percent of the time in an area south of Iceland to south and east of Greenland to the Labrador Coast north of Belle Isle. Another area of gale-force winds is east of Newfoundland, centered about 48°N, 36°W, and 5° latitude in radius. Another area is over the Gulf of Lions. The 10 percent occurrence line extends from about Cabo Finisterre to about 500 mi off Cape Hatteras where it turns northeastward to parallel the coast.

EXTRATROPICAL CYCLONES. This month LOWs form most frequently 150 to 250 mi off the East Coast, from Cape Hatteras northeastward to about the latitude of Cape Cod. This is part of a large area of cyclogenesis that extends from the Gulf Coast of the United States to the Bay of Fundy. Another major area of cyclone development and the path they follow is from the Grand Banks northeastward to Iceland. There also is a primary track northward from Newfoundland to southern Greenland, where it splits into the Labrador Sea and toward Iceland. Other tracks are over the northeastern ocean from west of Ireland toward the Barents Sea, from the English Channel across the Gulf of Finland, and from the Gulf of Lions southeastward across the Mediterranean Sea. The Gulf of Genoa is also a favorite area of cyclogenesis.

SEA HEIGHTS. Seas 12 ft or higher can be expected 10 percent of more of the time north of a line from a couple of hundred miles east of Cape Hatteras to Cape Finisterre, Spain. On the Mediterranean, 10-percent frequencies lie inside an ellipse stretching from Barcelona, Spain, to Crete and then northwestward to Sicily, Sardinia, and the Gulf of Genoa. Another small area of 10-percent frequency lies between Crete and Turkey. The coast of Colombia still hosts a 10-percent line off Barranquilla. An area of over 20 percent is located off the central coast of Norway. The highest frequencies of greater than 30 percent are found over a triangular area between 57°N, 43°W; 45°N, 42°W; and 62°N, 13°W; and in the Denmark Strait.

VISIBILITY. The frequency of low visibility (less than 2 mi) reaches 10 percent or more from Halifax, Nova Scotia, northeastward to a point near 50°N, 40°W, and then northwestward to near Cape Mercy. It also reaches 10 percent on the southeastern North Sea and over the waters around the Faeroe Islands and eastern Iceland. The frequency increases to more than 20 percent inside a coastal region from Cape St. John, Newfoundland, to Resolution Island and then southward to Ungava Bay, and over the Norwegian Sea north of about 72°N.

NORTH PACIFIC, FEBRUARY

WEATHER. February weather in general can be as rough as any month of the year over the middle and higher latitudes. The average central pressure of the Aleutian Low is 1000 mb and is near 51°N, 172°E. The subtropical Pacific High is 1020 mb and centered near 31°N, 138°W. A ridge of high pressure extends eastward from the central China coast. The 1033-mb Siberian High is centered over western Mongolia. The weather regimes are controlled by these three features.

WINDS. Westerly winds prevail over much of the ocean north of 30°N and west of 180°. Northerly winds dominate the East China Sea. Winds are variable over the central Aleutians, southeasterly over the western Aleutians, and easterly near the Pribilof Islands. From the Gulf of Alaska southward to near 40°N and east of 180°, winds are mostly southerly to southwesterly, although other directions are common during the frequent passage of LOWs. Over the extreme northern Gulf of Alaska, the prevailing winds are easterly, and northerly winds are very pronounced over the Bering Sea north of 60°N. The average speed of winds north of 30°N is force 4 to 6, although east of Honshu the wind blows at force 6 or 7, 41 percent of the time. The "northeast trades" extend northward to more than 20°N over most of the western and central ocean and to 30°N over eastern waters; south of 20°N, these winds are very steady. The wind speeds in the trades range from force 3 to 5. The "northeast monsoon" is steady over the South China Sea and the Philippine Sea south of 30°N and west of 150°E. Winds are quite variable over the eastern North Pacific between 30° and 40°N, southwesterly over the east-central ocean between 30° and 45°N, and variable over west-central waters between 25° and 30°N, and 135°E and 180°. Wind speeds over these areas usually average force 4. Northerly winds predominate over the Gulf of Tehuantepec, and in 71 percent of the observations they range between force 2 and 6.

GALES. The frequency of gales near and above 10 percent affects most noncoastal areas south of the A-

leutians and north of a line from the waters southeast of Honshu to a point south of the Queen Charlotte Islands and west of Washington State. A maximum incidence of over 20 percent is found over a 200-mi-wide band 600 to 1,000 mi southeast of the southern tip of Kamchatka, an area east of northern Honshu near 37°N, 155°E, and south of the Gulf of Alaska near 52°N, 145°W. Gale-force northerly winds are encountered more than 10 percent of the time by vessels plying the Gulf of Tehuantepec off southern Mexico. These high winds occur when strong northers from the Gulf of Mexico funnel across the isthmus to the Pacific. In extreme cases, they may be felt more than 200 mi out at sea.

EXTRATROPICAL CYCLONES. The storms predominantly follow a northeasterly track. The principal areas of cyclogenesis are off Hokkaido, the East China Sea, about 600 mi south of Unimak Island, and about the same distance southwest of Vancouver Island. Secondary tracks converge 350 mi east-northeast of Hokkaido and head east-northeastward toward the Rat Islands in the western Aleutians. A primary track extends northeastward from the East China Sea to the waters south of the western Aleutians and then runs parallel to that island chain to the Gulf of Alaska. The passage of LOWs over the Gulf of Alaska along the track described above and the one entering from the southwest is more confined to the western portion of the Gulf. The storm path approaching Vancouver Island from the southwest does not contain a maximum concentration of individual cyclones until it reaches a point 600 mi from that island.

TROPICAL STORM activity is at the annual minimum during February. On the average, one can be expected every 4 yr over western waters. As in the other winter months, the principal region of cyclogenesis is east of the central and southern Philippines. Two out of every seven February tropical storms has reached typhoon intensity in the past.

SEA HEIGHTS. Seas of 12 ft or more are encountered from 10 to 20 percent of the time over most of the ocean area between latitudes 30° and 52°N from 140°W to 145°E. A small area with a similar frequency lies over the waters bounding Taiwan where the "northeast monsoon" blows strongly and steadily. Areas of 20- to 30-percent frequency extend between latitudes 44° and 49°N from 172°E to 153°E, and farther southeast 100 to 200 mi around a line drawn from 35°N, 165°E to 40°N, 175°W.

VISIBILITY. Areas of limited visibility (less than 2 mi) occur in more than 10 percent of the observations north of a line drawn from the Yellow Sea through the Sea of Japan, south of Hokkaido, and then east-northeastward to the Alaska Peninsula. A maximum frequency of over 30 percent surrounds the waters around Ostrov Paramushir, south-southwest of Kamchatka.

NORTH ATLANTIC, MARCH

WEATHER. March is a transition month. The weather retains many of the wintry aspects of January and February and at the same time begins to exhibit some features typical of spring. During the first part of March, the weather is generally a continuation of winter conditions, gradually approaching springlike characteristics near the close of the month. However, wide variations from the climatic averages may be expected, and this pattern is not always the rule. The Icelandic Low (1005 mb) rests southeast of Kap Farvel near 58°N, 40°W, while the Azores High contains two 1020-mb centers southwest of the Azores near 27.5°N, between 35° and 42°W.

WINDS from westerly quadrants generally prevail over the major part of the western North Atlantic north of 30°N. Northerly or northeasterly winds blow more often over the waters between southern Greenland and western Iceland than any other winds from the four cardinal and four intercardinal points of the compass. Winds shift to a southerly component as one moves eastward from 35°W and to variable in direction over the Norwegian Sea east of 5°W. Near the coasts of Morocco and Portugal, northerly winds predominate. South of 30°N, the "northeast trades" are the dominant winds over most of the ocean with few exceptions. East of the Florida coast to about 68°W, wind directions are southeasterly to southerly. There is a strong tendency for easterly and southeasterly winds over the Gulf of Mexico. Over the Mediterranean, westerly to northwesterly winds prevail. For the month as a whole, winds of force 4 to 6 prevail north of 40°N (north of 35°N, west of 40°W) and force 3 to 4 south of 40°N (south of 35°N, west of 40°W).

GALES (force 8 or higher) tend to decrease in strength and frequency during the latter half of March. On the average, gale-force winds have been noted in 10 percent of the ship observations north of a line extending roughly from Cape Hatteras to the Bay of Biscay, excluding the southern Norwegian Sea, the waters south of western Iceland down to 60°N, the seas west of southern Ireland to about 33°W, and the waters east of Newfoundland. A small area of gale frequencies greater than 10 percent covers the Gulf of Lions. The maximum frequency of gale occurrence, 20 percent, may be expected from the southern tip of Greenland south to about 55°N and between 40° and 50°W.

EXTRATROPICAL CYCLONES. Principal storm tracks head from the Great Lakes and the Carolina coast to Newfoundland. From Newfoundland, a primary track curves northward to the west coast of southern Greenland, and another track runs northeastward to Iceland and then into the Barents Sea. Over the Mediterranean area, a primary track extends from the Bay of Biscay east-southeastward to the southern Turkish coast.

TROPICAL CYCLONES. Only one tropical storm, a hurricane in the Lesser Antilles in 1908, has been reported in the North Atlantic in the past 104 yr.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time north of a line from about 150 mi east of Cape Hatteras to Brest, France; in a small area northwest of Barranquilla, Colombia; in the Strait of Otranto between Italy and Albania; and from the coast of Sardinia northwestward to France. A large irregularly shaped area of 20-percent frequency lies in the open ocean bounded roughly by the following coordinates: 60°N, 55°W; 68°N, 25°W; 60°N, 10°W; 43°N, 43°W. Smaller areas of 20-percent frequency lie northeast of Bermuda, west of central Nor-

way, and in the Gulf of Lions.

VISIBILITY less than 2 mi occurs 10 percent or more of the time over a 400-mi-wide elliptically shaped area extending northeast-southwest from 55°N, 40°W to 42°N, 58°W; over an area of the Labrador Sea from Cape Mercy to Cod Island; over the North Sea from southern Norway southeastward to Denmark and Sweden; and north of a line extending from southern Greenland to north of Iceland and then to the Barents Sea.

NORTH PACIFIC, MARCH

WEATHER. March is normally considered one of the transitional months between winter and spring over the North Pacific. Compared to the North Atlantic, weather improvement is somehwat delayed by the vast expanse of the ocean and the lingering winter climate over Siberia. Stormy weather is about as frequent as in the preceding month along the northern routes, especially from the western Aleutians southwestward to the vicinity of Japan. The 1005-mb Aleutian Low lies about 250 mi south of the Komandorskiye Islands and the Pacific High (1022 mb) rests near 33°N, 144°W.

WINDS. From about 40° to 60°N, winds from the westerly quarter are most frequent, although winds are variable north of the Aleutians and easterly over the Gulf of Alaska. In 40 to more than 60 percent of the observations, the wind force is 4 to 6. However, near the North American coast the most frequent wind speeds are force 4 to 5. West to north winds are most prevalent in Japanese waters south of 40°N where more than 50 percent of all winds vary between force 4 and 6. During March, the northeast monsoon continues to prevail along the Asiatic coast south of Shanghai and over Philippine waters. From 25° to 40°N, wind directions are variable, and the force is from 3 to 5 more than 50 percent of the time. The "northeast trades" are the dominant winds from 25°N to the Equator and extend northward to about 30°N over the eastern part of the ocean. The usual wind speeds, force 3 to 5, persist more than 60 percent of the time over the ocean area under the influence fo the trades. Northerly force 2 to 3 winds blow 40 percent of the time over the Mexican waters out from the Gulf of Tehuantepec.

GALES. In the central and western North Pacific, gales may be expected as far south as 30°N. In this area, north of 35°N and west of 175°W, 10 to more than 20 percent of ship reports contain winds of force 8 or higher. Over the eastern part of the ocean east of 175°W, there is a large reduction in gale frequencies compared to February, and occurrences are generally confined to latitudes north of 35°N. Percentage frequencies of gales in the central Gulf of Alaska, 10 to 20 percent in the preceding month, drop to 5 to 10 percent during March. Gales over the Gulf of Tehuantepec may be expected more than 5 percent but less than 10 percent of the time.

EXTRATROPICAL CYCLONES. The greatest frequency of cyclogenesis in the Northern Hemisphere takes place in the area off the Ryukyus in March. These storms run northeastward to an area about 250 mi east of Hokkaido where they join another primary track coming from La Perouse Strait between Sakhalin and Hokkaido. East of Hokkaido, the primary paths head northeastward to the western Aleutians where they either continue into the eastern Bering Sea or curve to the east-northeast and parallel the Aleutians and Alaska Peninsula until reaching the Gulf of Alaska. Another track extends from 50°N, 160°W, to the Gulf of Alaska. A storm track heads east-southeastward from the Gulf of Alaska to the Alaska Panhandle.

TROPICAL CYCLONES are infrequent during March. A tropical storm can be looked for once every 2 yr over the western ocean. Half of these tropical storms develop further into typhoons. Tropical cyclones during March usually sprout up east of the central and southern Philippines and west of 170°W.

SEA HEIGHTS of at least 12 ft occur more than 10 percent of the time in a somewhat rectangular area bounded approximately by 50° and 33°N, and 155°E and 140°W.

VISIBILITY. The southern limit of 10-percent frequency of low visibility (less than 2 mi) extends from Mys Alevina, Siberia, southward to 42°N, 160°E, and then northeastward to west of Kodiak Island. This frequency increases to more than 20 percent from the waters around the northern Kurils northeastward to the Komandorskiye Islands and then northwestward to Mys Ozernoy.

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